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UNGULATA:—

RUMINANTIA.

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RODENTIA.

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EDENTATA.

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AVES.

R. BOWDLER SHARPE, F.L.S., F.Z.S.

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WATER DEERLET, OR CHEVROTAIN.

CHAPTER I.

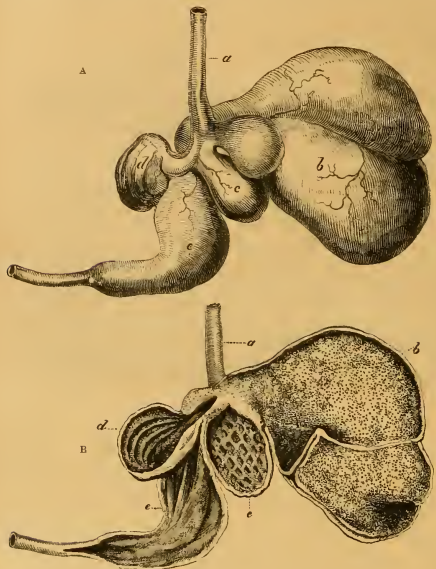
ARTIODACTYLA—RUMINANTIA: BOVIDÆ—SHEEP, GOATS, AND GAZELLES.

Ruminantia—Chewing the Cud—Metaphorical Expression—The Complicated Stomach: Paunch, Honey-comb Bag, Manyplies, Reed—Order of Events in Rumination—Feet and Dentition of Ruminants—Brain—Classification—HORNED RUMINANTS—Divided into two Groups—Difference between them—BOVIDÆ—Horns—Aberrant Members—SHEEP AND GOATS—General Characteristics—Sheep of South-Western Asia—Merino Sheep—Breeds of Great Britain—Dishley, or Improved Leicesters—Mr. Bakewell's Description—Southdowns, Cheviots, Welsh, and other British Breeds—Table of the Importation of Colonial and Foreign Wool into the United Kingdom—MARCO POLO'S SHEEP—OORIAL—SHAPOO—MOUFLON—AMMON—BURHEL—AMERICAN ARGALI—WILD SHEEP OF BARBARY—THE GOAT—Compared with the Sheep—Descent—Cashmere Goat—IBEXES—PASENG—Their remarkable Horns—Old Theories as to the Use of the Horns—MARKHOOR—TAHR—GAZELLES—General Characteristics—Sir Victor Brooke's Classification—THE GAZELLE—Appearance—Habits—ARABIAN GAZELLE—PERSIAN GAZELLE—SOEMMERING'S GAZELLE—GRANT'S GAZELLE—SPRINGBOK—SAÏGA—CHIRU—THE PALLAH, OR IMPALLA—THE INDIAN ANTELOPE, OR BLACK BUCK.

THE Swine, together with those animals which most nearly approach them, namely, the Peccaries and Hippopotami, form but a small division of the cloven-hoofed order of the Mammalian animals; by far the greater number of the species of the Artiodactyla being included in a group known familiarly as that of the Ruminantia, because, as part of the digestive process, they chew the cud.

This chewing the cud is a phenomenon restricted to the group of animals now under consideration, although it may be mentioned that some naturalists have thought that the Kangaroos among the Marsupials do the same to a certain extent.

As to the details of the process, the individual, a Cow, for instance, whilst grazing, nips off the grass between the large cutting teeth in the front of the lower jaw, and the tough pad which replaces in these creatures the similarly situated teeth of the upper jaw. After each mouthful it does not proceed to masticate the food, but swallows it forthwith, and continues thus to graze until it has satisfied its appetite. Seeking a quiet and shaded spot, it then seats itself that it may ruminate, or chew the cud, at leisure. If watched it will be seen that it commences shortly to perform a slight hiccough action, in which some contraction of the flanks is to be noticed. Its mouth, which was previously empty, is found to be full of what it is not difficult to recognise to be coarsely-masticated grass, which has been forced up into it; and this it immediately proceeds to chew between its back or grinding teeth, in a slow and continuous manner, moving its lower jaw uniformly from one side to the other—from right to left. When this chewing process has lasted for a time sufficient to convert the food into a pulpy state, it is again swallowed, after which another bolus is brought up to undergo a similar operation. And this is repeated at frequent intervals until most of the food swallowed has been masticated.



STOMACH OF A RUMINATING ANIMAL: (A) EXTERIOR, (B) INTERIOR.

A complicated stomach is necessary for the operation of this elaborate chewing process, the undisturbed duration of which has led to the word by which it is designated being applied metaphorically to a brooding condition of mind. Thus the poet of the "Night Thoughts" says:—

"As when the traveller, a long day past
In painful search of what he cannot find,
At night's approach, content with the next cot,
There ruminates awhile his labour lost."

This complicated stomach is not identical in all the Ruminantia. In the Camels and the Llamas it presents many points of difference from that of all the other members of the group, and in the Chevrotains it has slight peculiarities of its own.

This organ, as found in the Ox—and it is almost identically the same in the Giraffes, the Antelopes, the Sheep, and Deer—is seen to be divided into four well-defined compartments, as represented in the accompanying figures. These are known as—

1. The Rumen, or Paunch (*b*).
2. The Reticulum, or Honey-comb Bag (*e*).
3. The Psalterium, or Manyplies (*d*).
4. The Abomasum, or Reed (*e*).

The paunch (*b*) is a very capacious receptacle, shaped like a blunted cone bent partly upon itself. Into its broader base opens the œsophagus, or gullet (*a*), at a spot not far removed from its

wide orifice of communication with the second stomach, or honey-comb bag (*c*). Its inner walls are nearly uniformly covered with a pale skin (known as mucous membrane), which is beset with innumerable close-set, short, and slender processes (known as villi), resembling very much the "pile" on velvet. It is this organ, together with its villi, which constitutes the well-known article of food termed "tripe."

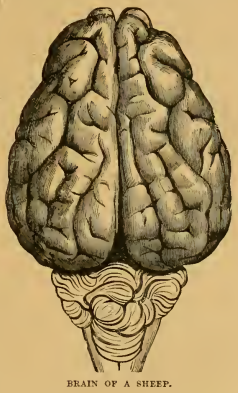
The honey-comb bag (*c*) is very much smaller than the paunch. It is nearly globose in shape, and receives its name on account of the peculiar arrangement of the ridges on the mucous membrane which lines it, these being distributed so as to form shallow hexagonal cells all over its inner surface, as seen in the figure on the previous page.

It is situated to the right of the paunch, with which, as well as with the manyplies (*d*), it communicates. Running along its upper wall there is a deep groove coursing from the first to the third stomach. This groove plays an important part in the mechanism of rumination; its nature must therefore be fully understood.

Its walls are muscular, like those of the viscus with which it is associated, which allows its calibre to be altered. Sometimes it completely closes round so as to become converted into a tube by the apposition of its edges. At others it forms an open canal.

The manyplies (*d*) is a very peculiar organ. It is globular, but most of its interior is filled up with folds, or laminæ, running between its orifices of communication with the second and fourth stomachs. These folds are arranged very much like the leaves of a book, and very close together. They are, however, not of equal depth, but form series of greater or less breadth. Their surfaces are roughened by the presence of small projections or papillæ.

The reed (*e*) is the stomach proper, corresponding with the same organ in man. Its shape is somewhat conical. The valve which partially obstructs its communication with the intestine is at the left of the foregoing figure. Its walls are formed of a smooth mucous membrane, which secretes gastric juice, and it is this stomach that, in the manufacture of cheese, is employed to curdle the milk.



BRAIN OF A SHEEP.

Whilst grazing, the possessor of this complicated stomach fills its paunch with the imperfectly masticated food, and it is not until it commences to chew the cud that any of the other parts are brought into play.

In the act of rumination, the following is the probable order of events:—The paunch contracts, and in so doing forces some of the food into the honey-comb bag, where it is formed into a bolus by the movement of its walls, and then forced into the gullet, from which, by a reverse action, it reaches the mouth, where it is chewed and mixed with the saliva until it becomes quite pulpy, whereupon it is again swallowed. But now, because it is soft and semi-fluid, it does not divaricate the walls of the groove communicating with the manyplies, and so, continuing on along its tubular interior, it finds its way direct into the third stomach, most of it filtering between the numerous laminæ on its way to the fourth stomach, where it becomes acted on by the gastric juice. After the re-masticated food has reached the manyplies, the groove in the reticulum is pushed open by a fresh bolus; and so the process is repeated until the food consumed has all passed on towards the abomasum, or true digestive stomach.

There are other features also which are characteristic of the ruminating animals. Their symmetrical four-toed feet (in which the thumb on the fore and the great toe on the hind are entirely absent) have the toes so proportioned that the axis of the limb runs down between the two middle toes at the same time that both the inside and outside toes are much reduced in size, and lost entirely in the Camel tribe, the Giraffe, and the Cabrit.

Another peculiarity which exists in all ruminating animals is the absence of cutting-teeth in the middle of the upper jaw; and it is only in the Camels and their intimate allies, the Llamas, that there are any upper cutting-teeth at all, they being replaced in all the others by a callous pad, on which the lower cutting-teeth impinge in mastication.

The canine teeth, which correspond to the tusks of the Lion and Dog, also deserve attention. Those of the lower jaw are always present, and are modified so as to appear like lateral cutting-teeth. In the upper jaw they are most often absent, but are enormous, projecting far down outside the lip, in the Musk, the Chinese Water Deer, and the Muntjacs. In some other Deer they are present, but small, and generally they are wanting.

The grinders are six on each side of each jaw, and are so formed that their surfaces wear down unevenly by the lateral movement to which they are subject during mastication. As in the Elephant, this depends upon each tooth being made up of alternate layers of enamel, dentine, and cementum, which, being of different degrees of hardness, are differently affected by the grinding action.

The ruminating animals exhibit a fair amount of intelligence, never, however, attaining that power of perception and memory exhibited by the Carnivora and other higher forms. The figure of the surface of the brain of the Sheep indicates that the convolutions of the brain are far from inconsiderable in number, and its allies of the same size agree with it in this respect, whilst larger species have more, and smaller less elaborate brain-markings, as is nearly always found to be the case in every group.

The accompanying table gives an outline sketch of the classification of the ruminating animals which has been adopted by zoologists:—

Sub-order.	*Section.*	*Division.*	*Group.*
RUMINANTIA.	TRUE RUMINANTS.	HORNED RUMINANTS.	Ox-tribe (*Bovidæ*).
			Deer-tribe (*Cervidæ*).
		CHEVROTAINS OR DEER-LETS (*Tragulidæ*)	
	CAMEL TRIBE. (*Tylopoda*).		

The large sub-order of the Ruminantia is seen to be primarily divided into two sections, namely, the typical Ruminants and the aberrant Ruminants (the *Tylopoda*). The typical Ruminants, in which the stomach is formed upon the plan of that described above in the Oxen, fall into two divisions, the smaller of which—that of the Chevrotains or Deerlets—possesses no psalterium, or third stomach, except in a rudimentary condition. The Horned Ruminants, including the Deer, Muntjacs, Elk, Oxen, and Antelopes, compose by far the largest number of the whole sub-order, and will be first described.

HORNED RUMINANTS.

The Horned Ruminants—with which, anomalous as it may at first seem, have to be included one or two hornless species, on account of their so closely resembling them in other respects—have their *cranial appendages developed after one or other of two principles*. In one group, which, from the fact that the Oxen are included with them, are named the *Bovidæ*, the horns are hollow, straight, or variously-twisted cones, supported upon bony prolongations from the forehead, resembling them in shape upon a smaller scale. These horns are permanent, except in the American Antelope, increasing in size each year, at the same time that they often exhibit transverse markings, which indicate the annual increase. In the other group—the *Cervidæ*, or Deer Tribe—the horns or antlers are deciduous, being cast off each year, to be shortly replaced by others, which share the fate of their predecessors. These antlers are entirely made of bone, and when fully grown are not covered with any less dense investment.

To commence, then, with the *Bovidæ*, or Oxen, and their allies.

THE BOVIDÆ, OR HOLLOW-HORNED RUMINANTS.

In these ruminating animals the permanent bone-cones on the forehead are covered with a black horny coating, which is not shed during the whole life of their owners, and in which, as they continue to grow until adult life at least, the tips are the oldest parts. The females in some species have horns like their mates, but smaller, as in the Ox and Eland; while in others—the Koodoo and the Sing-Sing Antelope, for example—the males alone are horned. The most aberrant members of this group are the Giraffe, the Cabrit, and the Musk, which will be considered after the less

MERINO SHEEP.

peculiar genera have been discussed. These include the Oxen, Bush-Bucks, Antelopes, Koodoos, Goats, Sheep, &c., which will be referred to more in detail.

THE SHEEP AND GOATS.*

Between the bearded Goat and the beardless Sheep there exist intermediate species, which so completely fill up the gaps that it is almost impossible to separate the two into different genera. With triangular, curved, and transversely-ridged horns in both sexes, a characteristic general appearance, and feet formed for mountain climbing, the species present differences which are recognised with facility.

With reference to the domestic Sheep, it is the opinion of most naturalists that it has descended from several distinct species. "Abel was a keeper of Sheep," is a Biblical statement from which the immense antiquity of a domestic breed may be inferred, whose origin cannot be better studied than by a comparison of the different forms found wild in Asia, the head-quarters of the genus. That no Sheep existed in Australia when that continent was first discovered is a well-known fact.

* The genus *Ovis*.

"Endowed by nature," as Mr. Spooner, in his work on the Sheep aptly puts it, "with a peaceable and patient disposition, and a constitution capable of enduring the extremes of temperature, adapting itself readily to different climates, thriving on a variety of pastures, economising nutriment where pasturage is scarce, and advantageously availing itself of opportunities where food is abundant," it is not to be wondered at that the animal has become the companion of man from the earliest times.

The fleece of the wild species of Sheep is composed of hair with wool at its roots, in the same way that in the Duck there is a covering of feathers and down. In the domesticated species the hair, by selection, has been reduced to a minimum, so that the wool forms the only coat.

In the southern parts of Western Asia many of the Sheep have a curious tendency to the deposition of fat on the tail rather than under the skin of the body generally, and this may occur to such an extent that the thus loaded caudal appendage may contain a large part of the entire weight of the body.

The Astracan breed, of small size, has a fine spiral black and white wool, sometimes entirely black, which is obtained from the lamb when the finest furs are required.

Of all the breeds of Sheep the Merino of Spain is one of the most important, on account of the excellence of its wool. In England the breed can hardly be said to exist, because the dampness of the climate does not suit its constitution. It is extensively found in Germany, and is *the* Sheep of Australia. The animal is small, flat-sided, and long-legged. The males have long horns, these appendages being absent in the females. The face, ears, and legs are dark, and the forehead is woolly, at the same time that the skin about the throat is lax. The body-wool is close-set, soft, twisted in a spiral, and short.

In Great Britain the breeds of Sheep are very numerous, some of the best being of quite recent origin. First among the heavy breeds are the Dishley, or Improved Leicesters, which, from their early maturity, aptness to fatten, smallness of bone, and gentle disposition, well deserve the high repute in which they stand. It is to the persevering energy and acuteness of Mr. Bakewell that we are indebted for the present animal, which in origin is far from pure bred. His aim was entirely in the direction of the carcass, and in his object he and his followers have quite succeeded, notwithstanding an inherent delicacy in constitution and an inferiority of the wool. "The head of this breed," we are told, "should be hornless, long, small, tapering towards the muzzle, and projecting horizontally forwards; the eyes prominent, and with a quiet expression; the ears thin, rather long, and directed backwards; the neck full and broad at its base, where it proceeds from the chest, but gradually tapering towards the head, and being particularly fine at the junction of the head and neck; the neck seeming to project straight from the chest, so that there is, with the slightest possible deviation, one continuous horizontal line from the rump to the poll; the breast broad and full; the shoulders also broad and round, and no uneven or angular formation where the shoulders join either the neck or the back, particularly no rising of the withers or hollow behind the situation of these bones; the arm fleshy through its whole extent, and even down to the knee; the bones of the leg small, standing wide apart, no looseness of skin about them, and comparatively bare of wool; the chest and barrel at once deep and round; the ribs forming a considerable arch from the spine, so as in some cases—and especially when the animal is in good condition—to make the apparent width of the chest even greater than the depth; the barrel ribbed well home; no irregularity of line on the back or the belly, but on the sides, the carcass very gradually diminishing in width towards the rump; the quarters long and full, and, as with the fore-legs, the muscles extending down to the hock; the thighs also wide and full; the legs of a moderate length; the pelt moderately thin, but soft and elastic, and covered with a good quantity of white wool, not so long as in some breeds, but considerably finer."

The large-sized Lincoln Sheep, with lengthy fleece, those of the Cotswold Hills, the Teeswater, and Romney Marsh, are also heavy breeds, not equal in the totality of their points to the Improved Leicesters, although excelling them either in quantity of wool or hardiness of constitution.

The Short-woolled Southdowns, with close-set fleece of fine wool, face and legs dusky brown, curved neck, short limbs, and broad body, is one of the oldest and most valuable unmixed breeds that we possess. Their mutton greatly excels that of the Improved Leicesters, which, taken in

association with their other good qualities, has caused them to extend to nearly every county. In parts of Hampshire, Shropshire, and Dorsetshire there are local breeds of Short-woolled Sheep which replace the Southdowns.

The Cheviot and the Black-faced, or Heath breed of our northern counties are mountain Sheep, of small size and hardy constitution, the former horned, the latter hornless and with a white face.

Welsh mutton is obtained from the small, soft-woolled Sheep with a white nose and face. The rams alone have horns, wherein the breed differs from that of the higher mountains, in which the ewes also are horned, at the same time that a ridge of hair is present along the top of the neck.

As wool forms so important an element of the mercantile transactions of Great Britain, and as Sheep-farming has so rapidly increased in Australia and New Zealand, a few words with reference to the statistics of the subject will not be out of place.

In 1788, when Governor Phillip landed at Port Jackson, there was not a Sheep in all Australia, and it was not until 1793 that about thirty of the Indian breed reached Sydney, their number being shortly augmented by the importation of breeding-stock from England and the Cape of Good Hope, principally Merinos. The progeny soon spread towards the interior, where the growing of wool became a lucrative pursuit. Sheep were first imported into New Zealand in 1840. It is estimated there are now one hundred million sheep in Australia, and nearly thirty million in New Zealand.

The following table of the number of bales of wool imported into Great Britain at twenty-year intervals, that is, in 1836, 1856, and 1876, gives a better idea than can be otherwise obtained as to the changes in the sources of wool as well as to the richness of each colonial district :—

IMPORTATION OF COLONIAL AND FOREIGN WOOL INTO THE UNITED KINGDOM (IN BALES).

	1836.	1856.	1876.
New South Wales and Queensland	19,066	59,342	169,874
Victoria	None	64,843	306,803
Tasmania	15,449	17,951	20,480
South Australia	None	16,618	102,067
West Australia	None	1,267	7,510
New Zealand	None	6,840	162,154
Total Australasian	34,515	166,861	768,888
Cape of Good Hope	1,740	50,607	169,908
Total Colonial	36,255	217,468	938,796
German	90,426	22,272	29,580
Spanish and Portuguese	20,451	8,106	7,906
East Indian and Persian	1,981	45,236	86,678
Russian	15,072	4,181	34,511
River Plate	16,653	5,151	118,593
Peru, Lima, and Chili		52,477	
Alpaca			
Mediterranean and Africa	14,714	13,665	
Mohair	No returns	13,515	
Sundry	12,784	10,735	
Total Foreign	172,081	175,338	277,268
TOTAL IMPORTATION	208,336	392,806	1,216,064

So much for the domestic Sheep; of other species of the genus *Ovis* we have Marco Polo's Sheep.* This splendid Sheep, one of the finest species of the genus, has horns, describing a spiral of about a circle and a quarter when viewed from the side, pointing directly outwards, and sometimes measuring as many as sixty-three inches from base to tip along their curve, and as much as four and a half feet from tip to tip. At the shoulder the animal measures just under four feet. It inhabits the high lands in the neighbourhood of the lofty Thian Shan mountains, north of Kashgar and Yarkand, not descending below an elevation of 9,000 feet above the sea level, often ascending much higher. It is

* *Ovis Poli.*

on account of the rarefaction of the air in these regions that there is considerable difficulty in obtaining specimens which have been wounded, because Horses at these heights are much distressed in their breathing, whilst the Sheep are not so. Mr. N. A. Severtzoff, an eminent Russian naturalist, has described three or four other species closely allied to Marco Polo's Sheep, which are smaller than it, from Turkestan and the district east of it. In this Sheep, during the winter, the sides of the body are of a light greyish-brown, changing to white below. There is a white mane all round the neck and a white disc round the tail. A dark line runs the whole length of the middle of the back. In summer the grey changes to dark brown.

The Oorial and the Shapoo are bearded Sheep, from Ladakh and the Suliman range of the

AMMON.

Punjab respectively, with large horns, which form not more than half a circle in the Shapoo and nearly a complete one in the Oorial. The colour of the Oorial is a reddish-brown above, paler beneath, the abdomen being white. A lengthy dark beard, reaching to the knees, fringes the whole length of the neck from the chin to the chest. The points of the horns are directed inwards. It is found at altitudes of 2,000 feet. The Shapoo is brownish-grey, white below, with a short brown beard. Its horns turn outwards at the tips. It is never found at altitudes lower than 12,000 feet.

The Mouflon at one time abounded in Spain, but is now restricted to the islands of Corsica and Sardinia. The species is a small one, of a brownish-grey colour, with a dark streak along the middle of the back, at the same time that there is a varying amount of white about the face and legs. The horns, present in the males only, are proportionately not large, curve backwards and then inwards at the tips. The tail is very short, in which respect they differ strikingly from the domestic Sheep, to which otherwise they are intimately related. The Mouflon frequents the summits of its native hills

AMMON.

in small herds, headed by an old ram. Its skin is used by the mountaineers for making jackets. It breeds freely with the domestic species.

The AMMON of Tibet has been known to measure as much as four feet and an inch at the shoulder, and has a most imposing appearance on account of the erect attitude in which it holds its head. Its horns attain a great size, being sometimes as much as four feet long and twenty-two inches in circumference at their bases, forming a single sweep of about four-fifths of a circle, their points being turned slightly outwards and ending bluntly. Its body colour is dark brown above, paler posteriorly and below. A mane surrounds its neck, white in the male, dark brown in the female. The tail measures only an inch in length. In the female the horns do not exceed twenty-two inches in length.

The BURHEL, or Himalayan "blue wild Sheep," stands three feet at the shoulder, and has horns which, commencing very close together on the forehead, describe a half circle of two feet or so, and are directed very much outwards and backwards. In the female the horns do not exceed eight inches in length, and stand backward instead of diverging. The coarse fleece of winter is of an ashy-blue colour, which, in summer, is replaced by one that is much darker. The abdomen is white, and a black stripe runs along each side of the body, the front of the legs and the chest being also black. It has no beard.

The AMERICAN ARGALI, or BIG-HORN, inhabits the range of the Rocky Mountains. Its height is three and a half feet at the shoulder. The horns form a complete circle, and are nearly three feet long in the male. They are said to come so far forward and downward that old rams find it impossible to feed on level ground. Its flesh is peculiarly well flavoured.

The WILD SHEEP OF BARBARY, known also as the TRAGELAPHUS, is a large and handsome species, with a comparatively lengthy tail, tufted at its end. The hair on the chin is short, whilst that along the lower margin of the neck, as well as on the front of the knees, attains a great length. The horns are not massive, and hardly exceed two feet in length. They are black, and are directed outward as well as backward.

THE GOATS.*

Modern naturalists, as intermediate forms become more numerous, find much difficulty in separating off the Goats (which constitute the genus *Capra* of earlier authors) from the Sheep (*Ovis*). In the Goats the horns are flattened from side to side, and rough in front and arched backwards, whilst in the Sheep they are more uniformly cylindrical, turned laterally, curling downwards, and

BARBARY WILD SHEEP.

often cork-screwed. A beard is a common addition to the former animal, and a most unpleasant odour is emitted by them.

The domestic Goat is almost certainly descended from the Paseng, or Ibex, of the mountains of Asia, with little or no admixture of other blood. In it, however, the female is bearded as well as the male, which is not the case with the Paseng. It has been subjugated from time immemorial, when the flesh of the kid was considered a delicacy. Its sure-footedness and its boldness are proverbial, as is its unpleasant odour. The power possessed by the species of ascending precipitate heights is marvellous. On more than one occasion it has been recorded—contrary to the teaching of Æsop—that whilst two individuals have met on a path too narrow for both to pass, one has lain down in order that the other might go over its back. With no great bulk of body; coarse hair of different lengths and tints, springing from out of a mass of much shorter wool; horns of varying size, but always out-turned at the tips; narrow ears, an almost entirely hair-covered nose; sight, hearing, and smell all acute; powerful thick-set legs, and a short tail naked below, it stands its own in mountainous and less civilised

* The genus *Capra*.

districts. Varieties occur with large pendulous instead of upright ears; others with extra horns, occasionally spiral as in Nepaul, or none at all. In the Angora and Cashmere breeds the hair is white.

The Goat of Cashmere is famous on account of the long and very fine wool with which it is covered, which is employed in the manufacture of Cashmere shawls. It is said that the wool of ten of these Goats is required for the material of a single shawl.

The IBEX is found in the Alpine heights of Europe and of Western Asia, including the Himalayas. The large scythe-blade-shaped horns of the male curve boldly upwards and backwards, diverging all the way. Along the front of their convex surfaces there is a series of protuberances or partial rings, which are only just indicated laterally. The largest specimens reach three feet

IBEX.

and a half in height at the shoulder, which is a little less than the length their horns sometimes attain. The body colour is a yellowish-grey, white below, with a dark brown line along the middle of the back. The soft and close-set hair hides an under-fur still finer. The beard is black. European specimens are smaller than those from Asia, rarely exceeding two feet and a half in height, with horns three feet in length. The species inhabits the most precipitous and dangerous parts of mountain regions, and is wonderfully sure-footed.

The PASENG is the wild Goat of Western Asia; it is also found on the northern side of the Caucasus and in some of the islands of the Ægean. In height the male measures two feet and three-quarters at the withers, the female being nearly six inches less. In the male the horns may measure as much as four feet in length. They are flattened, slender, curved backwards as part of a large circle, having their points turned sometimes inwards, so much so as now and again to cross, whilst at others they are directed outwards. Along their anterior edges are protuberances, separated by a greater distance as they approach the tips, indicative of the age of the animal, as after the third year a

fresh knob is formed in each succeeding one. Mr. Danford, who has made a special study of the species, remarks, with reference to the reputed use to which their owners turn their immense cranial appendages, that "regarding the use of the great horns carried by the Ibex family, the general idea among the older authors was that they were employed to break the animal's fall in leaping from a height. Pennant relates that Monardes was witness to the wild Goat saving itself in this way; and Gesner says: 'Cadens ab alto totum corpus inter cornua protegit a collisione et ictus lapidum magnorum excipit cornibus!'* This view is confirmed by Mr. Hutton, whose tame Aegagrus [Paseng] repeatedly used his horns for this purpose. I made many inquiries among the native hunters, and they all agreed

MARKHOOR.

in saying that the horns were never so used, or for any purpose except fighting; and the result of my own observations is, that during the leap the head is carried as far back as possible, though it may be that the situations in which I observed the animals did not necessitate the employment of the horns in the way referred to." The horns of the female are not more than a foot long, the knobs being almost obsolete. Unlike its consort, also, it has no beard. The general colour of the species is grey, shaded with reddish-brown. A blackish-brown line extends from the similarly coloured forehead along the spine.

The MARKHOOR, or "Serpent Eater," of North-east India and Cashmere, is a fine Goat of larger size than the Ibex, with much-flattened triangular horns, which, while running upwards from the head, are spiral and attain an immense size, sometimes as much as five feet along their curve. The spiral twist is much more open in some specimens than in others, depending on the locality in which they are found. The body colour is a dirty light blue-grey, the lengthy beard being of a darker colour. It inhabits very similar localities to the Ibexes and is very shy.

The TAHR of the Himalayas is a not common Goat, with small horns curved directly backwards,

* "Falling from a height, it protects its whole body, between its horns, from shock, and receives upon its horns the concussion of the huge stones."

not much more than a foot in length, flattened from side to side, with a notched anterior margin. The body colour is a fawn-brown; the hair of the neck, chest, and shoulders being of great length and reaching to the knees. In the female the horns are much smaller and of lighter colour. According to Captain Kinloch, "the Tahr is, like the Markhoor, a forest-loving animal, and although it sometimes resorts to the rocky summits of the hills, it generally prefers the steep slopes which are more or less clothed with trees. Female Tahr may be frequently found on open ground, but old males hide a great deal in the thickest jungle, lying during the heat of the day under the shade of trees or overhanging rocks. Nearly perpendicular hills, with dangerous precipices, where the forest consists of oak and ringall cane, are the favourite haunts of the old Tahr, who climb with ease over ground where one would hardly imagine that any animal could find a footing. Tahr ground, indeed, is about the worst walking I know, almost rivalling Markhoor ground; the only advantage being that, bad as it is, there are generally some bushes or grass to hold on to."

THE GAZELLES.*

Under the title of Gazelles are included several strikingly elegant, small, slender, sandy-coloured species of ruminating animals, in which the males always, and the females in most cases, carry horns, which are transversely ringed, and vary considerably in the direction which they take, many having them curved in such a way that the two together form a lyre-shaped figure, at the same time that in others they are nearly straight, turned slightly backwards or forwards, and diverging or converging at the tips. Where present, the horns of the females are more slender than in the corresponding males.

The Gazelles inhabit Africa, Arabia, Persia, India, and Central Asia only. They rarely exceed thirty inches in height at the shoulder; the largest, the Swift Antelope of Pennant (*Gazella mohr*), reaching nearly three feet. In all the Gazelles the face is marked with a white band running from the outer side of the base of each horn nearly down to the upper end of each nostril, cutting off a dark triangular central patch, and bordered externally by a diffused dark line. The under surface of the abdomen is white, and there is a dark line traversing the flank which bounds this. The rump is also white, which in many cases encroaches more or less upon the haunches.

Of the twenty species of Gazelles known to naturalists, only a few of the best known will be specially mentioned here. By Sir Victor Brooke they have been thus arranged, in accordance with certain easily ascertained distinctive features in coloration and shape of horn:—

I.—BACK UNSTRIPED.

A. *The white colour of the rump not encroaching on the fawn colour of the haunches.*

a. Both sexes bearing horns.

1. Horns Lyrate or Semi-Lyrate.

The Gazelle (Arabia and N.E. Africa).
Isabelline Gazelle (Kordofan).
Korin (Senegal).
Sundevall's Gazelle (Sennaar).
Black-tailed Gazelle (Bogosland).

2. Horns not Lyrate.

Cuvier's Gazelle (Morocco).
Small-horned Gazelle (Senaar).
Speke's Gazelle (Somali Country).
Muscat Gazelle (Muscat).
Arabian Gazelle (S. Arabia).
Bennett's Gazelle (India).
Dusky-faced Gazelle (Persia).

b. Females horniless.

Persian Gazelle.
Mongolian Gazelle.
Ladakh Gazelle.

B. *The white colour of the rump projects forward in an angle into the fawn colour of the haunches.*

Dama Antelope (S. Nubia).
Swift Antelope (Senegal).
Soemmerring's Antelope (E. Africa).
Grant's Gazelle (Ugogo).

II.—BACK WITH A MEDIAN WHITE STRIPE.

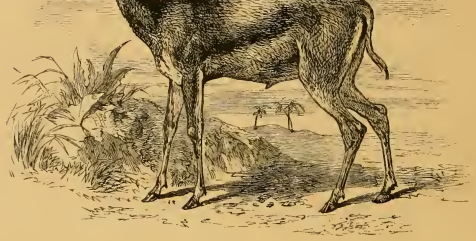
Spring-bok S. Africa).

The Gazelle *par excellence*, from Syria, Egypt, and Arabia, stands scarcely two feet high. The elegance of its proportions are too well known to need description. The beauty of its eyes is not to be

* The genus *Gazella*.

compared with that of some of the other ruminating animals, the whole face being far too sheep-like, and this remark equally applies to all its near allies. The Dorcas Gazelle is a name by which it is also known. Like many other members of the genus, it has a tuft of hair upon each knee. The tail is long and tapering; the body hair rather coarse and of a pale fawn colour. The hips, as well as the breast and the abdomen, are white. As to their habits, Mr. Blanford, in his work on Abyssinia, tells us that, so far as his observation went, "neither the Dorcas nor Bennett's Gazelle is ever seen in large flocks, like the animals of the Spring-bok group. Usually both are seen solitary, or from two to five together, inhabiting thin bushes generally on broken ground. They feed much upon the leaves of bushes. The male has a peculiar habit, when surprised, of standing still and uttering a short, sharp cry. Like most Antelopes, they keep much to the neighbourhood of some particular spot. After long observation, I am convinced that Bennett's Gazelle never drinks; and all that I could ascertain of the Dorcas Gazelle leads to the same conclusion in its case."

Captain Baldwin says that, "like other Antelopes, the little Ravine Deer [by which is meant



DORCAS GAZELLE.

Bennett's Gazelle] has many enemies besides man. One day, when out with my rifle, I noticed an old female Gazelle stamping her feet, and every now and then making that 'hiss' which is the alarm-note of the animal. It was not I that was the cause of her terror, for I had passed close to her only a few minutes before, and she seemed to understand by my manner that I meant no harm. No; there was something else. I turned back, and on looking down a ravine close by, saw a crafty Wolf attempting a stalk on the mother and young one. Another day, at Agra, a pair of Jackals joined in the chase of a wounded Buck.

"The Chikarah [again another name for Bennett's Gazelle] is as easily tamed as the common Antelope; they are favourite pets, and become strongly attached to those who rear and feed them. I have seen tame ones driven out with a herd of Goats to graze, and never attempt to make their escape. It is not at all unusual to find the wild Gazelles feeding close to, sometimes almost mingling with, herds of Goats, when the latter have been driven out to pasture. . . . . Like all Antelopes, the eyesight of the Chikarah is very acute, and the animal is perpetually on the watch against danger. It, however, appears to be gifted with only a moderate sense of hearing, and still less so of smell."

THE ARABIAN, OR ARID GAZELLE. is the same size as the preceding, differing, as may be gathered from the table given on page 13, in the shape of its horns, which, from being directed upwards and

outwards, turn at their tips more outward and also forward. The speed of the Gazelle, like that of most of its allies, is very great; its eyes are large and lustrous, and its general colour a rich yellowish-brown.

The PERSIAN GAZELLE stands twenty-six inches. Its body colour is grey fawn colour, the breast and abdomen being white. Of its habits, Major St. John says that, "like the wild Ass, it especially affects the neighbourhood of the salt deserts. It appears to retire generally to the valleys at the base of hills to breed, and is most commonly seen in small parties of three to half a dozen. The fleetest Greyhound cannot come up with the Gazelle when it gets a fair start; but when suddenly roused from a hollow, or when the ground is heavy after rain, good Dogs will often pull down males. The does are more difficult to catch."

SAÏGA.

SOEMMERRING'S GAZELLE stands two feet and a half high. The body colour is sandy fawn above; the horns are massive and lyrate, more slender in the female. It lives in pairs, and is a powerful species.

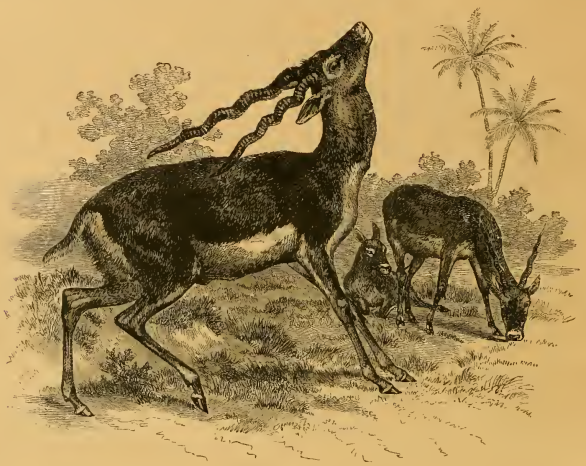
The horns of GRANT'S GAZELLE are larger than in any other of the species.

The SPRING-BOK derives its name from the habit it has of leaping straight up in the air for several feet when alarmed or whilst running. Its height is two feet and a half. The horns are lyrate, being very small in the females. Its colour is yellow dun, with the under parts, as usual, white. A peculiar white line along the middle of the back can be varied in extent within certain limits by the animal at pleasure. Major C. Hamilton Smith, when writing of this species, tells us that it assembles in South Africa in vast herds, "migrating from north to south and back with the monsoons. These migrations, which are said to take place in the most numerous form only at the interval of several years, appear to come from the north-east, and in masses of many thousands, devouring, like locusts, every green herb. The Lion has been seen to migrate and walk in the midst of the compressed phalanx, with only as much room between him and his victims as

the fears of those immediately around could procure by pressing outwards. The foremost of these vast columns are fat, and the rear exceedingly lean while the direction continues one way; but with the change of the monsoon, when they return towards the north, the rear become the leaders, fattening in their turn."

The Saïga* and Chiru† differ from the Gazelles but slightly, and approach the Sheep; the former belonging to Eastern Europe and Western Asia, the latter to Tibet.

The Saïga is as large as a Fallow Deer, tawny yellow in summer, light grey in winter; being specially peculiar about the nose which is much lengthened, at the same time that the nostrils are expanded to such a degree that in feeding they have to walk backwards. The horns, found only



INDIAN ANTELOPE.

in the males, are not a foot long, slightly lyrate, and annulated. In its native haunts—which are barren, sandy, and salt—it assembles frequently in vast herds. It runs rapidly when pursued, but is soon exhausted.

The Chiru is slightly smaller, of a reddish fawn colour, with the face and front of the limbs black. The slender jet-black horns, very small in the female, are ringed nearly to the tips, curved forward, and about two feet long. From Captain Kinloch's account we learn that "in the early part of the summer the Antelope appears to keep on the higher and more exposed plains and slopes where snow does not lie; as the season becomes warmer, the snow which has accumulated on the grassy banks of the streams in the sheltered valleys begins to dissolve, and the Antelope then comes down to feed on the grass which grows abundantly in such places, and then is the time that they may most easily be stalked and shot. They usually feed only in the mornings and evenings, and in the day-time seek more open and elevated situations, frequently excavating deep holes in the stony plains in which they live, with only their heads and horns visible above the surface of the ground."

* *Saïga tartarica.* † *Pantholops Hodgsoni.*

THE PALLAH.*

THE PALLAH, OR IMPALLA, of South and South-east Africa, is another closely-allied form of large size, being more than three feet high at the shoulder. Its colour is dark red above, yellow dun on the sides, and white below. There are no false hoofs in the usual situation on the lengthy legs: a peculiarity which it shares with the Cabrit and the Giraffe. The eyes are very large and liquid. The horns, wanting in the female, are twenty inches long in the male, and lyrate; they are ringed nearly to their tips. They are abundant on or near to hills, and collect in herds of from twenty to thirty. Mr. Drummond, vividly describing his South African experience, on an occasion whilst hunting Buffalo, "saw something red moving among the trees, and stopped to watch it. It turned out to be a troop of Impalla coming back from water and making for some of the grassy glades. There might have been seventy or eighty of them, picking their way along in Indian file, nibbling here and there, but always moving, and seeming like a troop of ghosts in the dim twilight and silence."

THE INDIAN ANTELOPE.†

THE INDIAN ANTELOPE, OR BLACK BUCK.—This species differs but little from the Gazelles in many respects, whilst its peculiarities are striking. Like the Nylghau, the male differs greatly from the female in its colour. The female has no horns; those in the male are black and of great size, spirally twisted for three or four turns like a corkscrew, slightly divergent, and often reaching thirty inches in length. It stands a little over two feet and a half at the shoulder. The colour of the males is deep brown-black above, with an abrupt line of separation from the pure white of the belly. This dark colour extends down the outer surface of each limb. The face is also black, with a white circle round the eyes and nose. In the females and young of both sexes the black and brown are replaced by a light fawn colour. The tail is very short and white below. At certain seasons of the year the glands below the eyes are much enlarged and form a prominent feature in the face of the male.

The Black Buck is one of the swiftest of the Antelopes, no Greyhound having any chance against it. Its flesh, being dry and unsavoury, is rarely eaten. The species falls a frequent prey to the Tiger, and is generally found in herds, fifty does, or so, accompanied by a single buck. The height to which they can bound is very great. According to Major C. Hamilton Smith, the native Indians "have raised the common Antelope among the constellations, harnessed it to the chariot of the moon, and represented it as the quarry of the gods. In the opinion of Hindoos the animal is sacred to Chandra, female devotees and minstrels lead it, domesticated, by the harmony of their instruments, or the power of their prayers, and holy Brahmins are directed to feed upon their flesh, under certain circumstances prescribed by the *Institutes of Menu*."

CHAPTER II.

RUMINANTIA: BOVIDÆ (*continued*)—ANTELOPES.

THE STEINBOKS: KLIPSPRINGER, OUREBI, STEINBOK, GRYSBOK, MADOQUA—THE BUSH-BUCKS—Appearance—Distinctive Marks—THE FOUR-HORNED ANTELOPES—Peculiarity in the Chikarah—THE WATER ANTELOPES: NAGOR, REITBOK, LECHÉ, AEQUTOON, SING-SING, WATER-BUCK, POKU, REH-BOK—THE ELAND—Beef—Appearance—Captain Cornwallis Harris' Description—Hunting—Scarcity—THE KOODOO—Appearance—King of Antelopes—ANGAS' HARNESSED ANTELOPE—THE HARNESSED ANTELOPES: GUIB—BUSH BUCK, OR UKOUKA—Appearance—Pluck—THE BOVINE ANTELOPES—THE BUBALINE—HARTEBEEST—BLESBOK—BONTEBOK—SASSABY—THE GNU—Grotesque Appearance—Habits—BRINDLED GNU—THE CAPRINE ANTELOPES—SEROW—Ungainly Habits—GORAL—CAMBING-OUTAN—YAKIN—MAZAMA—THE CHAMOIS—Distribution—Appearance—Voice—Hunted—THE ORYXES—BLAUBOK—SABLE ANTELOPE—BAKER'S ANTELOPE—ORYX—BEISA—BEATRIX—GEMSBOK ADDAX.

THE STEINBOKS.

THE KLIPSPRINGER, the OUREBI, the STEINBOK, and the GRYSBOK form a small section of the African Antelopes, elegant and small, with horns only in the males, these being straight, or nearly so. Their body hair is harsh. The Klipspringer stands a little under two feet high; it is the heaviest in build

* *Egyceros melampus.* † *Antilope bezoartica.*

of the four; its horns are four inches long and curved a little forward. Its colour is olive. It lives singly or in pairs, in mountainous districts, and it was at one time so abundant in the neighbourhood of the Cape of Good Hope that its hair was employed to stuff saddles with.

The Ourebi, in height and length of horn, resembles the last-mentioned species. Its build is very delicate, its general colour being a tawny yellow, white below. Its speed is very great. According to Mr. Drummond, "its peculiar colour so much resembles the soil on which it lies that, trusting to remain unobserved, it often allows you to get within fifteen or twenty yards of where it is squatting. It is a handsome and peculiarly graceful Antelope, extremely good eating, and well worth the hunter's attention. One thing he should bear in mind is, that however slightly they may be wounded, they will go and lie down within a few hundred yards, if not chased by a Dog, and will in such cases very generally allow him to get within shot again." The Steinbok is twenty inches high, with straight horns four inches long, large ears, and a mere stump of a tail. Its colour is red-brown, white below.

HEAD OF FEMALE BUSH-BUCK.

The Grysbok, with the same measurement, is chocolate-red.

The Madoqua of Abyssinia is not bigger than a Hare, standing fourteen inches high, the slender legs being comparatively long. The horns, present only in the males, are not more than half the length of the head, being nearly straight, and curved a little forward. The tail is a mere stump. The back is reddish-brown, the sides grey; the face, together with a peculiar tuft between the horns, is red, as are the legs. The under parts are white.

THE BUSH-BUCKS.*

The Bush-bucks form a clearly-defined group of small Antelopes peculiar to tropical and Southern Africa. They are also known by sportsmen as Duykers, or Bush-goats. They are characterised by the possession of horns in the male sex, which are short, straight, and simple cones, very much depressed, or slanting backwards, and rising some distance behind the eyes; at the same time that there is a tuft of lengthy hair, directed backwards, which is arranged in a kind of horseshoe shape between the ears. The crumen or gland in front of each eye is also peculiar. Instead of it being a sac with a circular opening, it is spread out in the form of a curved line, and not contracted to form an orifice at all. This feature, which is not observed in any other animal, may be seen in the drawing of the head of the female Bush-buck. The muffle, or extremity of the nose, is much like that of the Ox, comparatively large and always moist. The tail is very short, whilst the ears are of a fair size and oval in form. The legs are particularly slender and delicate, terminated by minute hoofs. In most the forehead is strongly convex. The coloration of the many species is not striking, being a uniform red-brown, dark bluish-grey, or sooty-black. The smallest of the species, the Pigmy Bush-buck, is not bigger than a Rabbit, and might at first sight, especially the female, be mistaken for a Deerlet. According to Mr. Drummond, "it feeds principally on certain berries and shrubs found growing in the jungles, and seems to be on the move, more or less, the whole day, though, in common with the rest of the animal creation, it is most often to be seen at early morning and evening."

Of the Bush-bucks, the Philantomba, of West Africa, is grey-brown; the Blau-bok, of Southern Africa, a bluish-grey; the Duyker-bok, of South Africa, a yellowish-brown; the Coquetoon, a deep

* The genus *Cephalophus*.

WATER-BUCK.

reddish-bay; the Bay Antelope, of West Africa, a dark bay, whilst there are other species black, brown, &c.

THE FOUR-HORNED ANTELOPES.*

In India and Tibet there are two peculiar species of small Antelopes, the true Four-horned and the Brown Indian Antelope. In the former of these, known also as the Chikarah, different from what is found as a natural condition in any other living animal, there are two pairs of well-developed horns; the hinder, which are the larger, being five inches long, in the usual situation; the smaller, an inch and a half long, are close together not far behind the eyes. In the Brown Indian Antelope the anterior pair of horns are rudimentary, and nothing more than knobs. All these horns are straight and conical. Neither species is common. Their size is about that of the Arabian Gazelle; their colour a reddish-brown, becoming lighter below; the hair is coarse; the female is hornless. Captain Kinloch says of them that "four-horned Antelopes are generally found alone, or frequently in pairs; they conceal themselves in long grass or among low bushes, and somewhat resemble hares in their habits. They are seldom to be seen out feeding, but usually jump up at the feet of the hunter and bound away at a great pace."

THE WATER ANTELOPES.†

The Nagor, the Reitbok, the Lechè, the Aequitoon, the Sing-sing, and the Water-buck are closely allied African Antelopes, with good-sized horns (only present in the males), which are transversely wrinkled, curved forwards, and a little inwards at the tips. Most of them are water-loving animals, and abound in marshy districts on the banks of rivers.

* The genus *Tetraceros*.

† The genus *Eleotragus* and its allies.

The Nagor is a little more than two feet and a half in height at the shoulder, the horns being six inches long, and the tail ten inches. The colour of the long, loose hair is fulvous-brown above, white below. The Reitbok is of a grizzly ochreate colour. Its height is nearly three feet, the horns being twelve inches long. According to Dr. Kirk, the species is "commonly found feeding in small herds; in the heat of the day it rests in long grass, and may be approached within fifty yards before starting. It seldom runs far without stopping to look round. Before again making off it gives a shrill whistle, as it does often when first started. Should the female have young unable to run far, and danger near, she places her foot on the shoulder and presses it to the ground; after which it never moves

ELAND.

until almost trodden upon, and is expected to remain in the same spot until the return of the mother." The Lechè is of a pale brown colour above and white below. Sir John Kirk says it "is a water Antelope, frequenting damp, marshy places, and taking to impassable swamps, among reeds and papyrus. It goes in considerable herds, accompanied by several males, mingling often with the 'Poku,' another Antelope peculiar to that region (the valley of the Zambesi). In the distance the Lechè may be known by the peculiar way in which it allows its horns to recline back, almost touching the withers." The Poku, Vardon's Antelope of Livingstone, is smaller than the Lechè, and thicker in the neck; otherwise it closely resembles it.

The Sing-sing Antelope and Water-buck are much alike, the former wanting a white elliptical patch, which is found near the base of the tail in the latter. The body colour is a greyish-brown. Long hair on the neck produces a mane. At the shoulder they stand four feet six inches, and the pale horns are two feet and a half long. "The Water Antelope," says Mr. Drummond, "is an extremely fine animal, and so plentiful that there are, perhaps, more of them shot than of any of the other large Antelopes. The large ringed horns which, in the male, crown its brow, bear a strong resemblance to

those of the Reedbuck [Reitbok], while the habits and general appearance of both species are almost identical. Both frequent thickets and reedy places near water, and are principally found in pairs or small groups. The hair of the species [of Water-buck] inhabiting Eastern Africa is very long and coarse, though that of the one found in Central Africa [the Sing-Sing] is remarkably soft, and is highly prized by the natives as being so."

The Reh-bok of South Africa, "though almost approaching a Fallow Deer in size, more nearly," says Mr. Drummond, "resembles a Chamois in other particulars; indeed, it has been called the African Chamois, and so far deserves the title, that it certainly possesses many of the characteristics and habits of the European species—decidedly more so than any other of the Antelope genus found in South Africa, with the exception of the Klipspringer. Their colour is light grey, the hair being somewhat long and coarse, and the horns are straight [bent forwards at the tips], and by no means unusually large for the animal's size. They are never found but on the bare hills, among rocks and stones, and their powers of springing are wonderful. It seems extraordinary how their delicate limbs escape injury, when they take bound after bound like an indiarubber ball, in places that a Cat would shudder at." According to Major C. H. Smith, "it is an animal of great swiftness, moving with wonderful rapidity by lengthened stretches, close to the ground, so as to seem to glide over the desert like a mist driven by the winds, and, favoured by the indistinct colours of the fur, is immediately out of sight. The Bushmen and western tribes [of South Africa] make lance-heads, awls, and other tools of the horns, and occasionally cloaks of their skins for the women."

THE ELAND.*

This fine species attains to the size of an Ox, the bull standing six feet and a half at the withers. Attempts have within the last few years been made to breed it in England for the sake of its flesh, which is as good as the best beef. It is, however, found to be impossible to get the price sufficiently low for market purposes. Two varieties are known, one of a pale fawn colour from Central Africa, the other, from South Africa, of a bright yellow tan colour, marked transversely with narrow white lines, about fifteen in number, running from a black line which goes along the back, to the belly. These marks are present in all young individuals, and disappear or fade considerably in the adults. The full-grown bull has a broad tuft of lengthy slight brown hair on the forehead, between and in front of the horns, which are situated some distance behind the eyes, being straight, a foot and a half in length, and at their bases carrying a thick and conspicuous screw-like ridge which extends in some cases nearly to their ends. In the females the horns are never quite so large as in the males. A large dewlap hangs from the throats of the bulls, whilst a dark, short mane continues from the forehead backwards. The tail is about two feet and a quarter in length, with a large tuft of brown hair at its end.

According to Captain W. Cornwallis Harris, "in size and shape the body of the male Eland resembles that of a well-conditioned Guzerat Ox, not unfrequently attaining the height of nineteen hands, and weighing two thousand pounds. The head is strictly that of an Antelope, light, graceful, and bony, with a pair of magnificent straight horns, about two feet in length, spirally ringed, and pointed backwards. A broad and deep dewlap fringed with brown hair reaches to the knee. The colour varies considerably with the age, being dun in some, in others an ashy blue with a tinge of ochre; and in many also sandy-grey approaching to white. The flesh is esteemed by all classes in Africa above that of any other animal; in grain and colour it resembles beef, but is better tasted and more delicate, possessing a pure game flavour, and the quantity of fat with which it is interlarded is surprising, greatly exceeding that of any other game quadruped with which I am acquainted. The female is smaller and of slighter form, with less ponderous horns."

When writing on the hunting of these creatures, known in South Africa as the *Impoofo*, the same author remarks that, "notwithstanding the unwieldy shape of these animals, they had at first greatly exceeded the speed of our jaded horses, but being pushed they soon separated; their sleek coats turned first blue and then white with froth; the foam fell from their mouths and nostrils, and the perspiration from their sides. Their pace gradually slackened, and with their full brilliant eyes turned imploring towards us, at the end of a mile, each was laid low by a single bullet."

* *Oreas canna.*

With reference to these animals, the Hon. W. H. Drummond tells us that "more Eland are killed from horseback than on foot; for as it is utterly out of the question to make a practice of running them down, and as they generally inhabit the treeless flats, where they cannot, except by chance, be stalked, while the uncertainty of their movements and their keeping out of cover render it impossible to find them, like the large animals, by the aid of their spoor, some more certain method is needed than the chance meetings which occur to the hunter when in pursuit of other game, more especially as their hide is held in great repute by the Dutch colonists, who make trek-tows for their wagons, and reins for their oxen from it, even preferring it to that of a Buffalo. The demand thus induced has so diminished their numbers as to have restricted this noble Antelope to a few favoured localities, even in which it is becoming more scarce every day, while not many years ago it formed a component part of almost every landscape in the southern and eastern portions of Africa."

THE KOODOO.*

This is one of the handsomest of all the Antelopes. It is more slender in build and smaller than the Eland, which it somewhat resembles. The horns are about four feet long, and form most graceful

KOODOO.

open spirals like corkscrews, there being a ridge along their whole length. The females are hornless. The ear is large and trumpet-shaped, moved at the slightest noise towards its source. The eyes are large and liquid. The body colour is slaty-grey, with transverse white markings, like those on the striped variety of the Eland. A small mane extends along the neck and withers, and another from the chin to the throat and breast. The tail is of moderate length, and hairy. This species is most abundant in Southern Africa, but it extends as high as Abyssinia. It is able to travel with very great speed, and makes prodigious bounds. It stands about five feet in height at the shoulders.

"Majestic in its carriage," writes Captain Harris, with all the enthusiasm of a true sportsman, "and brilliant in its colour, this species may with propriety be styled the king of the tribe. Other Antelopes are stately, elegant, or curious, but the solitude-seeking Koodoo is absolutely regal! The ground colour is a lively French grey approaching to blue, with several transverse white bands passing over the back and loins: a copious mane, and deeply fringed, tricoloured dewlap, setting off a pair of

* *Strepsiceros kudu.*

ponderous yet symmetrical horns, spirally twisted, and exceeding three feet in length. These are thrown along the back as the stately wearer dashes through the mazes of the forest or clambers the mountain-side. The old bulls are invariably found apart from the females, which herd together in small troops, and are destitute of horns."

ANGAS' HARNESSED ANTELOPE.*

This elegant animal, much like the Koodoo in its proportions, stands three feet four inches high at the shoulders. In the male, which alone bears horns, these appendages are nearly two feet long, twisted and sub-lyrate, having sharply-pointed tips of a pale straw colour, their other parts being of a brownish-black, deeply ridged for half their length from their bases. The colour of the body is greyish-black, tinged with purplish-brown and ochre, white transverse stripes, like those of the Koodoo, being present on the neck, flanks, and cheeks. A black mane courses down the neck, whilst from the neck and belly depends long shaggy hair in abundance, reaching to the knees. The ears are large, and the face is of a bright sienna-brown. The tail is one foot eight inches long, black above, with under side and tip white. The female is small, and of a bright rufous colour, with transverse stripes more numerous than in the male.

This species is found in troops of eight or ten together, feeding on the mimosa bushes in the Zulu country. Closely allied to it is a second from Central Africa, which is of a dull bay, nearly uniform, colour, the horns reaching thirty inches in length. It is known as Speke's Antelope.

THE HARNESSED ANTELOPES.†

The Harnessed Antelopes proper are all of small size, the elegant Guib not being larger than a Goat, its proportions being infinitely more delicate. It is of a pale bay colour, and the distinct transverse white streaks, running down from the middle of its back with connecting bands, have given the origin to its name.

The Bush Buck differs in wanting any body stripes. It is also African. Writing of it, Mr. Drummond remarks that the Bush Buck, "the male of whom is known as the 'Ukouka,' and the female as the 'Umbabala,' and which differ so greatly that experience is necessary to teach one that they are of the same species, is undoubtedly the finest in every way of all the Antelopes, whether found in the [Cape] Colonies or interior, that are known to the hunter as 'small game.' In size it resembles a full-grown Fallow Buck, weighing, according to age and condition, from nine to thirteen stone; its colour is a dark reddish-brown, often verging into black, and with indistinct markings on the sides, haunches, and legs; it has a great deal of hair, and a considerable mane, while the neck, which is thick out of all proportion, is nearly bare. The last mentioned peculiarity detracts from the otherwise graceful outlines of its body, the more so, perhaps, from the head being so finely shaped and small. The horns are nearly straight, rough, and ringed for about three inches from their base, and then taper away, smooth and polished, to an almost invisible point; they vary from nine inches to a foot long, and from the way in which they are set on the skull, the immense strength in the neck and shoulders of the animal, and their extreme sharpness, form about as formidable weapons as could well be imagined, especially as their owner is the most plucky Antelope, without exception or consideration of size, with which I have become acquainted in Africa. I do not think that in all my experience . . . I remember a single instance in which a Ukouka has not tried to charge when wounded and brought to bay; and no one, even after a very moderate experience, would ever allow any Dog on which he placed any value to attack them."

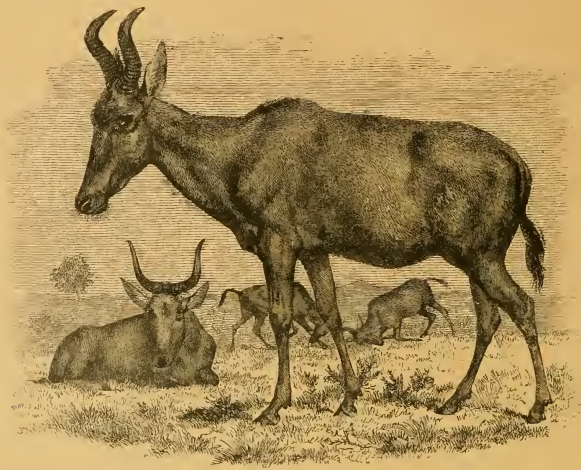
THE BOVINE ANTELOPES.‡

The Bubaline Antelope, together with the Hartebeest, has a peculiarly elongated and narrow head, at the same time that the body is not elegant in its proportions, being triangular in form, heavy in the shoulders, and falling away behind. The horns, which are smaller in the females, are turned abruptly backwards at their tips after having been directed forwards and upwards in a lyrate manner. The Bubaline of North Africa is of a uniform bay colour, and the much more recently discovered

* *Euryceros Angasii.* † The genus *Tragelaphus.* ‡ The *Damalidæ.*

Tora Antelope of Eastern Africa resembles it in this respect, whilst its horns differ slightly in their direction and size, being more divergent and slender. The Hartebeest is grey-brown, and black on the outer sides of the limbs, with large, triangular white spots on the haunches; a black line also runs down the middle of the face from between the horns.

Mr. Pringle, when writing on the Hartebeest, says of it that it "is one of the largest and handsomest of the Antelope family. . . . In the nooks of the narrow ravines, through which the game are wont to descend from the steep and stony mountains, for change of pasturage, or to drink at the fountains that ooze from their declivities, I have frequently found fresh skulls and horns of the Hartebeest, those slight relics being all that remained to indicate that there the Lion had surprised



BUBALINE ANTELOPE.

and rent his prey, and that the ferocious Hyæna had followed and feasted on the fragments, devouring even the bones, except the skull and a few other unmanageable portions."

The Blesbok, Bonte-bok, and Sassaby are about the size of a calf three months old. Their horns are lyrate and ringed at their bases. The two former are of a purple-red colour, white faces and white rumps. Of the Blesbok, Mr. C. J. Andersson remarks—"It is of a beautiful violet colour, and is found in company with black wilde-beests and Spring-boks in countless thousands, on the vast green plains of short, crisp, sour grass occupying a central position in South Africa. Cattle and Horses refuse to pasture on the grassy products of these plains, which afford sustenance to myriads of this Antelope, whose skin emits a most delicious and powerful perfume of flowers and sweet-smelling herbs."

The Sassaby, or Bastard Hartebeest of the Cape colonists, stands four feet and a half in height. It has strong horns a foot in length, crescentic, with the points directed inwards. Its body colour is a dark purple-brown above, which changes into dusky-yellow underneath, a slate-coloured patch extending from the shoulder and the hip down to the knee and hock, at the same time that the rump is fawn-coloured. The tail is nearly two feet long.

THE GNUS.*

The Gnu and the Brindled Gnu are two of the most grotesque of creatures. With the head not unlike that of a small Cape Buffalo, it has the limbs and hind-quarters not unlike those of a pony, in proportions as well as size. The nose is broad and flattened, with a bristly muzzle. The horns are broad at the base, where they nearly meet, and after turning downward as well as forward, they again turn up abruptly in a hook-like manner. They are found abundantly in Southern Africa, where, as their flesh is worthless, they are not much hunted. They are extremely wild and fearless, and remarkably tenacious of life. Their speed is great, and they have a habit of prancing about and kicking out furiously when suspecting danger. Both species have a mane along the neck, and lengthy hair between the forelegs. In both the tail is long, covered with a mass of hair not unlike that of the Horse.

The Common Gnu is of a deep brown-black, the tail and mane being white, whilst the bushy beard, running back to the chest and between the forelegs, is black. Lengthy black hairs, diverging

GNU.

and ascending from a median line, cover the upper part of the nose, at the same time that other smaller tufts under the eyes help to give a most ferocious aspect to the face. From Captain Harris's description of the animals of South Africa, an excellent idea of the peculiarities of the creature may be gained. "Of all quadrupeds," he writes, "the Gnoo is probably the most awkward and grotesque. Nature doubtless formed him in one of her freaks, and it is scarcely possible to contemplate his ungainly figure without laughter. Wheeling and prancing in every direction, his shaggy and bearded head arched between his slender and muscular legs, and his long white tail streaming in the wind, this ever-wary animal has at once a ferocious and ludicrous appearance. Suddenly stopping, showing an imposing front, and tossing his head in mock defiance, his wild red sinister eyes flash fire, and his snort, resembling the roar of a Lion, is repeated with energy and effect. Then lashing his sides with his floating tail, he plunges, bounds, kicks up his heels with a fantastic flourish, and in a moment is off at speed, making the dust fly behind him as he sweeps across the plain."

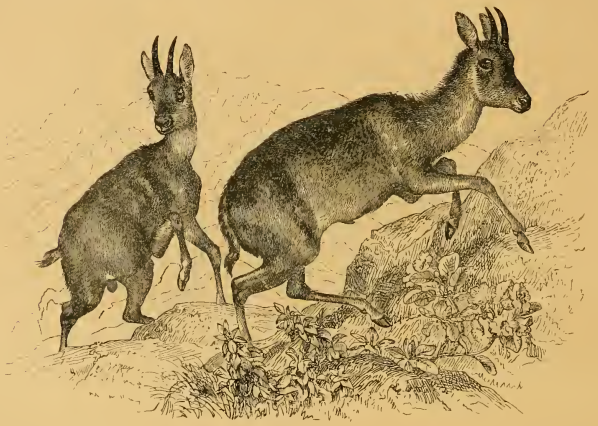
In the Brindled Gnu the front of the face lacks the lengthy hair of its ally; the tail is also black instead of white. Its body colour is a dirty dun, variegated with obscure pale streaks. This species, as well as the Common Gnu, is the constant companion of the equally abundant Quaggas of the same region.

* The genus *Catoblepas*.

THE CAPRINE ANTELOPES.

The Serow (sometimes written Surrow) of India, the Cambing-outan of Sumatra, with the Goral of North India, form a small group of strongly-built Goat-like Antelopes, with short, conical, upright horns, ringed at the base, and of nearly equal size in both sexes. The feet are large, and the tapering tail short.

Captain Kinloch gives us the following account of the Serow. He says it "is an ungainly-looking animal, combining the characteristics of the Cow, the Donkey, the Pig, and the Goat! It is a large and powerful beast. . . . The body is covered with very coarse hair, which assumes the form of a bristly mane on the neck and shoulders, and gives the beast a ferocious appearance, which does not belie its disposition. The colour is a dull black on the back, bright red on the sides, and white underneath, the legs also being dirty white. The ears are very large; the muzzle is coarse. . . . The



GORAL.

Serow has an awkward gait; but in spite of this can go over the worst ground; and it has, perhaps, no superior in going down steep hills. It is a solitary animal, and is nowhere numerous; two or three may be found on one hill, four or five on another, and so on. It delights in the steepest and most rocky hillsides, and its favourite resting-places are in caves, under the shelter of overhanging rocks, or at the foot of shady trees."

Of the Goral, the same author remarks that it "is an active little beast, and much resembles a small Goat, but the back is more arched. The prevailing colour is a brownish-grey, with a dark stripe along the back, and dark markings on the legs. Underneath the throat is a large white spot, which is very conspicuous when the animal is standing above one, and often betrays its presence when it would otherwise have escaped observation. The hair is soft but rather coarse, and about two inches long." In the male the horns reach nine inches in length.

The Cambing-outan stands about two feet and a quarter at the shoulder. Its long, coarse hair is brown-black in colour, the mane and throat alone being white. The horns are not more than six inches in length, cylindrical, slightly annulated and curved backwards at their lips. Mountain forests where it leads a particularly active life, are its haunts.

Dr. J. Anderson remarks of the TAKIN, or BUDORCAS, another allied species, "Major Stewart informs me that it is found in all the high ranges of the north-east of Debrooghur, and is far from uncommon. The Mishmees, with their very inferior appliances to shoot and catch them, are, nevertheless, frequently dressed in their skins, or have a part of a skin with the hair on as an ornament, which would seem to indicate that they are numerous. . . . They are seen in pairs, and sometimes in herds of twenty or more. They are swift of foot and good climbers."

In Formosa and Japan there are also Goat-like Antelopes, that from the former locality being named after Mr. Swinhoe, who discovered it. Its horns are short and conical, its brown fur harsh and crisp. Both closely resemble the Cambing-outan. There is still another with a long tail inhabiting Northern China.

The MAZAMA, or Mountain Goat of California and the Rocky Mountains, is an allied species, with short, thick, conical, recurved horns, and long, straight, soft hair of a white colour, specially abundant in the region of the throat, shoulders, sides, and tail. Its size is that of a large Sheep, which it much resembles in physiognomy. The flesh has an unpleasant musky flavour, the skin is thick and spongy, at the same time that the hair is considered of but little value.

HEAD OF THE CHAMOIS.

THE CHAMOIS.*

This well-known Goat-like Antelope inhabits the snow-clad mountains of Europe, from the Pyrenees to the Caucasus, ascending during the summer, and in winter going below the line of snow in search of food. Both sexes possess horns—black, short, and cylindrical—rising perpendicularly and parallel from the forehead for some distance, then forming a small hook directed backwards to their pointed tips. These rarely exceed seven inches in length. The female is slightly smaller than the male, which stands a little over two feet at the shoulder. In winter the colour of the lengthy, hairy coat is dark brown, which becomes a brownish-yellow in the summer, a darker streak along the back alone remaining. The head is pale yellow, darker from the nose upwards to between the ears and around the eyes. Behind the horns and between the ears is a pair of peculiar glands, opening externally, the function of which is unknown. The voice of the species is a rough bleat under all ordinary circumstances: but when the one which watches whilst the others feed—and there is always found to be one such in every herd—finds cause to fear, it gives a shrill whistle as a danger signal to its companions.

The senses of sight, hearing, and smell of the Chamois are developed to a maximum, and this fact, taken in association with the animal's great sure-footedness among the lofty, snow-covered Alps, in which it has its home, makes hunting it a task of no mean difficulty and danger. Dogs are of no service on the rocky eminences to which the Chamois will retreat when it is pursued, and the sportsman has to rely upon his own surefootedness and courage in climbing the steep and slippery precipices, whither he is tempted by the sight of game. If so hard pressed that it is driven to some height beyond which it cannot go, it is said that it will precipitate itself upon its pursuer, sending him down into the depths below. Besides man, the eagle is an enemy whose constant endeavour is to obtain the kids from their watchful mothers. Its skin is much valued for its toughness combined with its pliability. Its flesh is also greatly esteemed.

* *Rupicapra tragus.*

THE ORYXES.*

Of the Antelopes there is a fairly well-marked section, distinguished by the possession of horns in both sexes, at the same time that the body is peculiarly deep at the shoulder, whilst the lengthy tail is cylindrical and tufted at the extremity. Among these there is a mane along the neck in three closely-allied species, the Blaubok, or Equine Antelope of South Africa, the Sable Antelope of the Transvaal and the eastern coast of Africa, and Baker's Antelope, or the Maarif of Upper Nubia, as well as in the Oryx, which is found in many parts of Africa, the Beisa of Abyssinia, the Beatrix Antelope of Arabia, and the Gemsbok of South Africa; whilst in the not distant Addax Antelope of North Africa there is no nape-mane, but a slight one on the throat.

ORYX.

In the Blaubok, which stands more than four feet and a half at the shoulder, with a glaucous grey coat upon a black skin; in the Sable Antelope, which stands four feet and a half, being black except upon the abdomen, as well as in streaks upon the face, which are white; and in Baker's Antelope, which stands four feet eight inches, being of a pale fulvous liver colour, the horns are two feet and more in length, and curved gently backwards, being ringed transversely except at the tips, where they are smooth. In the Oryx, the Beisa, the Beatrix Antelope, and the Gemsbok, the lengthy conical horns, although similarly ringed, are much more slender, starting backwards in a line with the face, whilst in those previously mentioned they rise at an angle from it, being straight in the Gemsbok and Beisa, very slightly curved backwards in the Beatrix, and more so in the Oryx. In the nearly allied Addax the similarly-constructed horns are gently twisted in a corkscrew manner. All these last-mentioned Antelopes are pale in colour, being almost white, with the throat protected by long black hair.

Whilst speaking of the Beisa Antelope, Mr. Blanford remarks that "the appearance of a herd of Oryx is very imposing. They are some of the most elegant and symmetrical of animals, the motions

* The genus *Oryx*.

being those of a Wild Horse rather than of an Antelope. Their favourite pace appears to be either a steady quick walk or a trot; they rarely break into a gallop unless greatly alarmed. When frightened they dash off, sometimes snorting and putting their heads down, as if charging, raising their long tails, and looking very formidable. They are wary animals, though far less so than some other Antelopes. It is said that they frequently attack when wounded, and their long, straight horns are most deadly weapons."

Of the Gemsbok, Captain Harris tells us that it "is about the size of an Ass, and nearly of the same ground colour, with a black list stripe down the back and on each flank, white legs variegated with black bands, and a white face, marked with the figure of a black nose-band and head-stall, imparting altogether to the animal the appearance of being clad in half-mourning. Its copious black tail literally sweeps the ground; a mane reversed, and a tuft of flowing black hair on the breast, with a pair of straight, slender horns (common to both sexes) three feet in length, and ringed at the base, completing the portrait." The resemblance between the Gemsbok, when seen from the side view, and the Unicorn of heraldry, is sufficiently striking to make it more than probable that the conception of the latter originated in the former.

The author just quoted says of the Blaubok, or Roan Antelope, by which name it is also known, that it "is an inhabitant of the elevated downs and ridges about the source of the river Limpopo [four degrees to the west of Delagoa Bay, and a little north of it], and being utterly destitute of speed, may be ridden to a standstill without difficulty. . . . It is heavily built, and has an upright mane, long asinine ears, and robust scimitar-shaped horns."

CHAPTER III.

ARTIODACTYLA: RUMINANTIA—BOVIDÆ (*Concluded*).—OXEN, PRONGHORN ANTELOPE, MUSK [DEER], AND GIRAFFE.

THE NYL GHAU—Description—Habits—THE MUSK OX—Difficulties in associating it—Distribution—Habits—THE OX—Chillingham Wild Cattle—Their Habits—Domestic Cattle—The Collings, Booth, and Bates Strains—American Breeding—Shorthorns, and other Breeds—Hungarian Oxen—Zebu—Gour—Gayal—Curious mode of Capturing Gayals—Banting—THE BISONS—Description—European Bison, or Aurochs—Almost extinct—Cæsar's description of it—American Bison—Distribution—Mythical Notions regarding it—Their Ferocity and Stupidity—"Buffalo" Flesh—THE YAK—Habits—THE BUFFALOES—Varieties—Description—Fight between two Bulls—THE ANOA—THE PRONGHORN ANTELOPE—Peculiarity as to its Horns and Skull—Professor Baird's and Mr. Bartlett's Independent Discovery of the Annual Shedding of the Horns—Habits—Peculiarity about its Feet—Colour—Difficulties as to its Position—THE MUSK [DEER]—Its Perfume—Where is it to be placed?—Description—Habits—Hunters for the Perfume—Their Sufferings—THE GIRAFFE—Peculiarities—Skull processes—Its Neck—Habitat—Running power—Habits—Hunting.

THE NYL-GHAU, OR BLUE OX.*

THIS is the largest of the Antelopine animals found in India, the adult male standing over four feet in height at the shoulders, which are at a considerably higher level than the haunches. The female is about one-third smaller than her consort, and without horns, which in the male are but short, rarely exceeding nine inches in length, and rising perpendicularly from the head. Each horn is black, smooth, angular, and turned slightly forward, ending in a sharp point.

The body colour of the male is a slate blue, darker about the head and under parts of the body, whilst the legs are black; the female is tawny-red; the aged bull is nearly black. A short mane runs along the neck and over the highest part of the shoulder, in which latter situation it is of greater length. There is a considerable tuft of dark hair hanging from the middle of the front of the neck, over six inches in length, which is situated just below a conspicuous white, anchor-shaped throat-patch, the shank of which runs up between the two halves of the lower jaw almost to the lip. On each cheek also there is a circular white spot below and behind the eye. A transverse

* *Portax picta.*

white line above and below each fetlock stands out conspicuously also. The inner sides of the thighs are white, this colour extending for some distance upwards and inwards. There is a white patch also in front of each pastern joint. The tail is lengthy, and tufted at the end. The ears are nearly of the same length as the horns. The limbs are elegantly shaped, though rather heavy, and their proportions show a tendency towards those of the Giraffe, which animal it also resembles in the employment of its tongue for seizing food, and not its lips.

The Nyl-Ghau is found only in continental India, where it abounds in parts, not being a favourite with sportsmen, because its small horns are so insignificant a trophy, but more so with the larger members of the Cat tribe—the Tiger and the Leopard—as well as the wild Dog, with whom it is a frequent meal. Its temper is uncertain, which fact, when taken in connection with its powerful build, makes it a dangerous pet. It lives well in confinement. When attacking, it drops on its knees, and thus advances until it feels itself within a sufficient distance of its foe to make a sudden leap upon it, which it can do with great velocity and force. The leather manufactured from its skin is valuable, but its flesh is never eaten by the Hindoos, on account of their belief that it belongs to the Ox tribe, which it is not lawful to slay. With a good Horse in open country, the Blue bull may be hunted successfully with spears. It is very tenacious of life. The first specimens introduced into England were brought from Bombay by Lord Clive in 1767.

NYL-GHAU.

THE MUSK OX*

is an animal whose exact affinities it is not easy to determine. By some naturalists it has been thought to be intermediate between the Sheep and the Ox, whence its scientific generic name, *Ovibos*. It is found only in Arctic America north of latitude 60°, and exhales a strong musky odour at certain seasons of the year, an approach to which is recognisable in several of the Bovidæ. It is a heavy-built, but not large creature, with short legs, and a very lengthy brown hairy coat, which almost reaches to the ground. Its horns are very similar in form to those of the Cape Buffalo, and in the bulls they meet in the middle line of the forehead. The tail is very short, being entirely hidden by the fur of the haunches. The nose is not naked, as in the Oxen, but is almost entirely covered with hair, as in the Elk and Reindeer, both Arctic ruminants also. The spread of their feet is considerable, and they can cover the ground at no little speed. Captain Franklin describes their habits as follows:—"The Musk Oxen, like the Buffalo, herd together in bands, and generally frequent barren grounds during the summer months, keeping near the rivers, but retire to the woods in winter. They seem to be less watchful than most other wild animals, and when grazing are not difficult to approach, provided the hunters go against the wind. When two or three men get so near a herd as to fire at them from different points, these animals, instead of separating or running away, huddle closer together, and several are generally killed; but if the wound is not mortal they become enraged, and dart in the most furious manner at the hunters, who must be very dexterous to evade them. They can defend themselves with their powerful horns against Wolves and Bears, which, as the Indians say, they not unfrequently kill. The Musk Oxen feed on the same substances as the

* *Ovibos moschatus.*

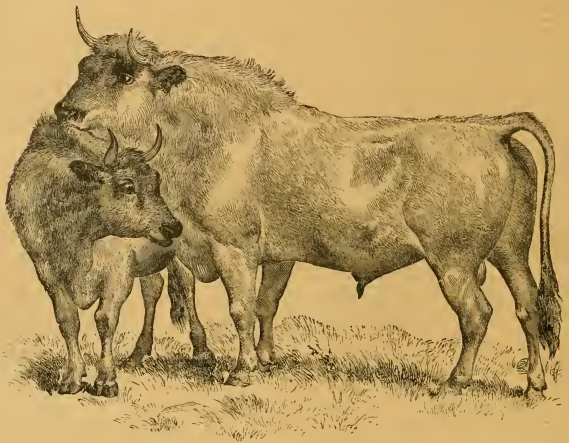
SABLE ANTELOPE. (See p. 28.)

(From the Living Specimen in the Zoological Gardens, London.)

Reindeer; and the prints of the feet of these two animals are so much alike, that it requires the eye of an experienced hunter to distinguish them. The largest killed by us did not exceed in weight three hundred pounds."

THE OX.*

It being quite unnecessary to describe the general form and proportions of this animal, as seen among us in a domesticated state—Shorthorns, Alderney, Highland, &c.—we will at once proceed to notice the famous cattle of Chillingham Park, in Northumberland, which are known to have been in existence in the thirteenth century. The wild cattle there are all cream white, with a brown muzzle, with the insides and tips of the ears reddish-brown, at the same time that the horns are white tipped with black, of which latter colour are the hoofs. Calves more or less coloured are



CHILLINGHAM CATTLE.

occasionally born, but these are promptly destroyed by the keepers. Some of the bulls have a thin, short mane. Their habit, on strangers approaching them, is to "set off in a full gallop, and at a distance of about two hundred yards make a wheel round and come boldly up again, tossing their heads in a menacing manner. On a sudden they make a full stop at the distance of forty or fifty yards, looking wildly at the object of their surprise; but upon the least motion being made, they all again turn round and fly off with equal speed, but not to the same distance, forming a shorter circle; and again returning with a bolder and more threatening aspect than before, they approach much nearer, probably within thirty yards, when they again make another stand, and then fly off. This they do several times, shortening their distance, and advancing nearer and nearer, till they come within such a short distance that most people think it proper to leave them, not choosing to provoke them further." They differ from domestic cattle in that they feed at night, and generally sleep during the day. They also hide their calves.

In all the so-called wild cattle of Great Britain the forehead is flat or slightly concave, the head is small, the back is straight, and the legs are short.

* *Bos taurus.*

It is now almost universally agreed that domestic cattle are descended from two or three species of the genus Bos, which existed in late geologic or prehistoric times, the remains being found in Switzerland, Ireland, and other parts of Europe. The Zebu, Yak, Gayal, and Arni, to be referred to immediately, have also been domesticated.

Cattle have been so distributed and mixed in breeding that any precise arrangement of the breeds according to their ancestral affinities can scarcely be tabulated. Most important of the heavy breeds are the well-known Shorthorns of the north of England, so carefully and successfully developed by Charles and Robert Colling between 1780 and 1818, at Ketton and Barmpton, close to Darlington, in Durham, by a process of in-and-in breeding—"Hubback," *the* "Duchess," "Lady Maynard,"

HUNGARIAN BULL.

"Young Strawberry," "Foljambe," and "Comet," the last bull of which, at Charles Colling's sale in 1810, fetched a thousand guineas.

Following close upon the Collings came the Booths—Richard, Thomas, and J. Booth—between 1814 and 1864, at Studley, Killerby, and Warlaby, where "Isabella," the twin sisters "Necklace" and "Bracelet," were parents of goodly herds, "Commander-in-Chief" being one of the latest gems. On one occasion, it is stated, Mr. Richard Booth, of Warlaby, refused the unique offer of fifteen hundred guineas for a cow named "Queen of the May."

In 1810 Thomas Bates, of Ridley Hall, and afterwards of Kirkleavington, then a well-known breeder of cattle, purchased at Charles Colling's sale "Young Duchess," daughter of "Comet," a granddaughter of "Duchess" by "Daisy" bull, and she became the founder of the famous "Duchess" tribe. In 1831, with the accession of the bull "Belvidere," a descendant of Robert Colling's "Princess" tribe, the "Duchess" breed produced "Short Tail" and the renowned "Duke of Northumberland." The "Matchem" cow, purchased at the same date, did much to improve the stock. Mr. Bates died in 1849.

Several enterprising American breeders have, since 1817, introduced Shorthorns into the United

States and Canada, Colonel Lewis Sanders, of Kentucky, being the first who did so on anything like thorough principles. Others followed his example with success, especially about the year 1852, when a fresh impulse was given to their production because of the rise of price in meat, as well as the foreign demand for it. The Booth and Bates bloods predominate in these animals, and form the basis of much of the beef now re-shipped to England.

The great advantage of the Shorthorn breed is that they, together with a good temper, combine the advantages of great size and aptitude to fatten, rapidly reaching maturity. For dairy purposes they are excelled by the Suffolk Duns and Ayrshire cattle, the latter, with their enormous udders, broad hips, and deep flanks, being the best as milkers. Hereford, North Devon, and Scottish black Shorthorns are inferior to those of the northern counties in their slowness of growth and power of filling out. Those of North Devon are particularly symmetrical in form. The mountain cattle of the western Highlands, otherwise known as the Kyloe breed, are best known from the hardiness of their constitutions, protected as they are by their thick hides and shaggy coats. The Welsh and Shetland cattle resemble them in many respects.

In Hungary, Turkey, and Western Asia there is a breed of large cattle with peculiarly long and slender outward-spreading horns, black-tipped, and greyish throughout the rest of their length.

In India, the Sacred Cattle, or ZEBUS, with convex forehead, short horns, large drooping ears, and a short head, possess a high hump upon the withers, as well as an ample dewlap falling in undulating folds along the whole length of the neck. Their disposition is mild, as is indicated by their expression, and the liberty they are allowed in India is wonderful. They vary greatly in size, some being not bigger than an average month-old calf. The breed has extended in times gone by through Persia into Eastern Africa, where it is found with a narrower and flatter face, at the same time that the hump is smaller.

The introduction of steam, as well as the extension in the employment of the Horse, has almost entirely superseded the use of cattle as beasts of burden or draught in highly civilised nations.

The GOUR, the GAYAL, and the BANTING are three species of wild cattle found in the Oriental world from India to Java, peculiar in possessing a ridge running along the middle of the back, and horns which, after running outwards from the head, are directed upwards and not backwards. Of these the Gour of Central India is the largest, measuring six feet at the withers, having also a convex profile, very high withers, and an arched back, which makes the line from the nose to the root of the tail, along the spine, a fairly continuous curve. Its colour is a deep brown glossy black, excepting a ring of white encircling the base of each hoof, and a white tuft on the forehead. There is not any trace of a dewlap in either sex. The horns are not more than two feet in length, strong, and curved boldly upwards at their tips. The Gour is found abundantly in herds of twenty or so around the table-lands, especially of South Bahar, feeding on the young leaves of the trees and shrubs. It appears to have resisted all attempts at domestication. The Gayal is found in the hill-region east of the Brahmaputra. It is much the size of English cattle. The bull is bold, and the cow easily domesticated. Its home is the deep jungle, where it can obtain the young leaves and shoots of the brushwood. According to Mr. Macrae the following is the method employed by the Kookies of the Chittagong hill-region to catch the animal:—"On discovering a herd of wild Gayals in the jungle, they prepare a number of balls, of the size of a man's head, composed of a particular kind of earth, salt, and cotton. They then drive their tame Gayals towards the wild ones, when the two herds soon meet and assimilate into one; the males of the one attaching themselves to the females of the other, and *vice versâ*. The Kookies now scatter their balls over such parts of the jungle as they think the herd most likely to pass, and watch its motions. The Gayals, on meeting these balls as they pass along, are attracted by their appearance and smell, and begin to lick them with their tongues; and relishing the taste of the salt, and the particular earth composing them, they never quit the place until all the balls are consumed. The Kookies, having observed the Gayals to have once tasted their balls, prepare a sufficient supply of them to answer the intended purpose, and as the Gayals lick them up they throw down more; and it is to prevent their being so readily destroyed that the cotton is mixed with the earth and the salt. This process generally goes on for three changes of the moon, or for a month and a half, during which time the tame and the wild Gayals are always together, licking the decoy balls, and the Kookie, after the first day or two of their being so, makes his appearance at such a distance as not to alarm the wild

ones. By degrees he approaches nearer and nearer, until at length the sight of him has become so familiar that he can advance to stroke his tame Gayals on the back and neck without frightening the wild ones. He next extends his hand to them, and caresses them also, at the same time giving them plenty of his decoy balls to lick. Thus, in the short space of time mentioned, he is able to drive them, along with the tame ones, to his parrah, or village, without the least exertion of force; and so attached do the Gayals become to the parrah, that when the Kookies migrate from one place to another, they always find it necessary to set fire to the huts they are about to abandon, lest the Gayals should return to them from the new grounds."

The Gayal carries its nose forwards, as a rule, like a Buffalo. Its ears are longer than those of the Ox. It possesses a dewlap smaller than in the Zebu. The tail is short, not descending below the hock. Its general colour is a varying and generally dark brown, the abdomen and the legs being white in parts. Its cry is a shrill, insignificant lowing. Its horns are conical, turned directly outwards, and a little upwards at their tips, not exceeding one foot and a half in length.

The Banting extends from Cochin China, through the Indo-Malay archipelago, to the islands of Bali and Lombok. Its colour and proportions are almost exactly those of the Gour.

THE BISONS. *

Closely related to the Oxen are the Bisons of Europe and of North America, together with the Tibetan Yak. The two species of Bison agree closely with one another in general appearance, the American form being shorter and weaker in the hind-quarters, and a little smaller altogether.

The hair of the head and neck is very abundant and long, forming a mane of very dark colour, at the same time that it nearly conceals the eyes and ears as well as the base of the short conical horns, which are directed outwards and upwards. Under the chin there is a lengthy beard. A line of lengthy hair also extends along the back nearly to the tail, which is itself only covered with short soft hair, except at the end where there is a lengthy tuft. There is a hump developed on the shoulders, at which spot the adult male is nearly six feet in height, the female being smaller.

The European Bison, or Aurochs, is on the verge of extinction, surviving only in the forests of Lithuania, Moldavia, Wallachia, and the Caucasus, on account of the severe laws against its destruction. The horns are longer and more curved than in the American species. The females are less hairy and smaller than their mates. Its strength is very great, and an old bull is said to be a match for at least four Wolves. Its speed is considerable, and it raises its hoofs above the level of its lowered head whilst galloping.

In his description of the Black Forest (*Sylva Hercynia*) Cæsar describes the species (the Urus) thus:—"They are but little less than Elephants in size, and are of the appearance, colour, and form of a Bull. Their strength as well as their speed is very great. They spare neither man nor beast that they see. They cannot be brought to endure the sight of men, nor can they be tamed, even when taken young. The people, who take them in pitfalls, assiduously destroy them; and young men harden themselves in this labour, and exercise themselves in this kind of chase; and those who have killed a great number, the horns being publicly exhibited in evidence of the fact, obtain great honour. The horns, in magnitude, shape, and quality, differ much from the horns of our Oxen. They are much sought for, and after having been edged with silver at their open ends, are used for drinking vessels at great feasts."

According to some authorities, however, it is a mistake to identify the European Bison with the Aurochs.

To all intents and purposes the American Bison is an extinct animal, killed off by the rifle and the rail and the encroachment of man upon its haunts. A few specimens are preserved with what may be described as laudably jealous care in the Yellowstone Park, and small herds may be found in Montana, Texas, and Canada.

Huge herds, numbering millions of individuals, "so numerous as to blacken the plains as far as they can reach," were once a common sight on the prairies, and repeatedly stopped the Kansas Pacific Railway when first formed. Hunters spread false notions as to the organisation of these herds,

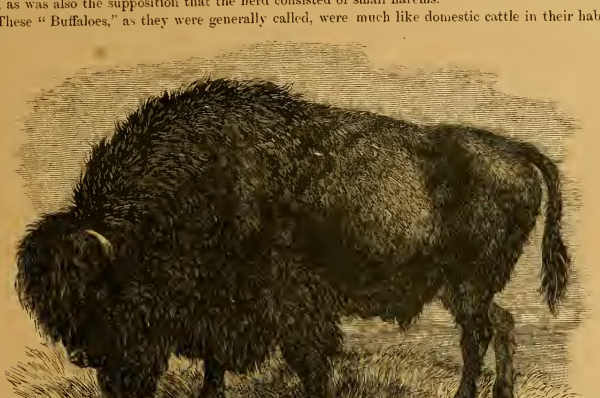
* The genus *Bison*.

BISON.

(From the Living Specimen in the Zoological Gardens, London.)

which was of a most simple character, excellently explained by Mr. Allen, who says that the timidity and watchfulness of the cows, accustomed as they were to the care of their offspring, led them to take the initiative in the movements of the herd, and this kept them near the front, especially when the herd was moving. The popular belief that the bulls kept the cows and the young in the middle of the herd, and formed themselves, as it were, into a protecting phalanx, had some apparent basis; but the theory that the old bulls, the least watchful of all the members of the herd, were sentinels posted on the outskirts to give notice of an approaching enemy, was wholly a myth, as was also the supposition that the herd consisted of small harems.

These "Buffaloes," as they were generally called, were much like domestic cattle in their habits.



AMERICAN BISON.

They were, however, fond of wallowing in the mud, and so coating themselves with a protection from their insect pests. Their ferocity of appearance was not evident in their true natures, for their disposition was sluggish and fearful. Colonel Dodge remarked of them that, "endowed with the smallest possible amount of instinct, the little he has seems adapted rather for getting him into difficulties than out of them. If not alarmed at sight or smell of a foe, he will stand stupidly gazing at his companions in their death-throes, until the whole herd is shot down. He will walk unconsciously into a quicksand or quagmire already choked with struggling dying victims. Having made up his mind to go a certain way it is almost impossible to swerve him from his purpose."

The flesh of the "Buffalo" was thought equal to the best beef if from the young animal, but dry and insipid when from the adult. The tongue and hump were esteemed great delicacies. Pemmican was made mostly from the dried flesh, pounded fine and mixed with an equal weight of tallow.

The YAK differs from the Bisons mostly in the distribution of its long hair, which, instead of being situated on its hump and neck, forms a lengthy fringe along the shoulders, flanks, and thighs, and completely invests the tail, which latter is much prized in India, where it is known as "Chowry," and is employed as a fly-switch in great ceremonials.

The Yak is a native of the high ground of Tibet, where it is rigorously protected by the native government against the foreign sportsman. Its colour is black, except some spots upon the face, which are white or grey. Its tail is often white, as is frequently the long hair tuft on the top of the withers. Its horns reach nearly a yard in length, and are directed outwards, forwards, and then upwards. Its voice is much like that of a Pig, whence the name Grunting Ox, by which it sometimes goes.

As to the habits of the creature, Captain Kinloch tells us that "the Yak inhabits the wildest and most desolate mountains; it delights in extreme cold; and is found, as a rule, at a greater elevation than any other animal. Although so large a beast, it thrives upon the coarsest pasturage, and its usual food consists of a rough, wiry grass, which grows in all the higher valleys of Tibet, up to an elevation of nearly 20,000 feet. . . . Yak seem to wander about a good deal. In summer, the cows are generally to be found in herds varying in number from ten to one hundred, while the old bulls are for the most part solitary or in small parties of three or four. They feed at night or early

YAK.

in the morning, and usually betake themselves to some steep and barren hillside during the day, lying sometimes for hours in the same spot."

THE BUFFALOES.*

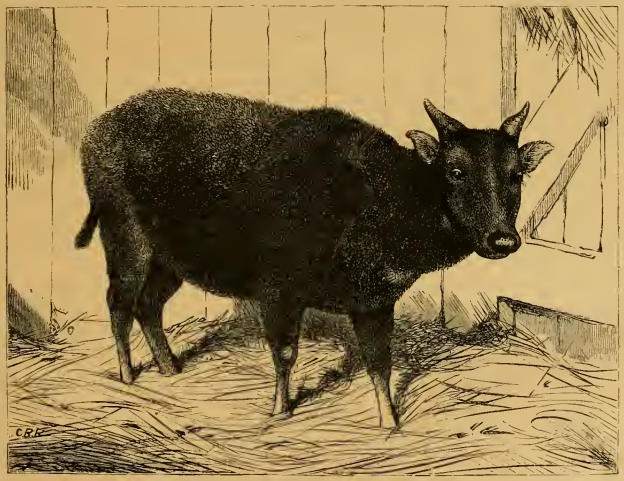
The Buffaloes have the horns flattened and triangular in section, inclined outwards and backwards, turning up at the tips. The Common Buffalo is found in Southern Europe, North Africa, and the Indian region. The huge Indian variety, with most lengthy horns, is also known as the Arni. Its horns are elongated and narrow, sometimes reaching six feet and a half in length. It stands nearly or quite six feet at the shoulder, its proportions are bulky, and its general colour dusky-black. It lives in small herds numbering not more than twenty, and solitary bulls are often met with which attack sportsmen in a most vicious manner without provocation. The Cape Buffalo has shorter horns, expanded at their bases, so that they almost meet in the middle line of the forehead. It is found all over Central and South Africa, and is a formidable animal when wounded, as, quite regardless of the cloud of smoke which follows the shot aimed at it, it charges right through it, and so does

* The genus *Bubalus*.

frequent injury to the experienced hunter. Its general colour is blue-black, but in some cases it has a reddish tinge. The Hon. W. H. Drummond gives the following account of a fight between two bulls of which he was an eye-witness. After having had his attention attracted by a loud clattering noise, he remarks that, "on looking through the edge of the last thicket which had concealed them, I saw two Buffalo bulls standing facing each other with lowered heads, and, as I sat down to watch, they rushed together with all their force, producing the loud crash I had before heard. Once the horns were interlocked they kept them so, their straining quarters telling that each was doing his best to force the other backwards. Several long white marks on their necks showed where they had received scratches, and blood dripping over the withers of the one next me proved that he had received a more severe wound. It was a magnificent sight to see the enormous animals, every muscle at its fullest tension, striving for the mastery. Soon one, a very large and old bull, began to yield a little, going backwards step by step; but at last, as if determined to conquer or die, it dropped on to its knees. The other, disengaging its horns for a second, so as to give an impetus, again rushed at him, but, whether purposely or not I could not tell, it did not strike him on the forehead, but on the neck, under the hump, and I could see that with a twist of his horns he inflicted a severe wound. However, instead of following up his seeming advantage, he at once recoiled, and stood half facing his antagonist, who, getting on his legs again, remained in the same position for several minutes, and then with a low grunt of rage, rushed at him. This time he was not met, and his broad forehead struck full on his rival's shoulder, almost knocking it over. The old bull then went a few yards off and stood watching the other for fully a quarter of an hour, when he walked slowly away in the opposite direction."

The Cape Buffalo, which is found all over Africa south of the equator, is replaced in the north-eastern portion of the continent by a smaller variety, of a browner colour, and with much shorter horns, which are not closely approximated at their bases, at the same time that they spread out almost horizontally instead of curving downwards and backwards.

In western and the western-equatorial parts of Africa there is again another still smaller variety,



ANOA.

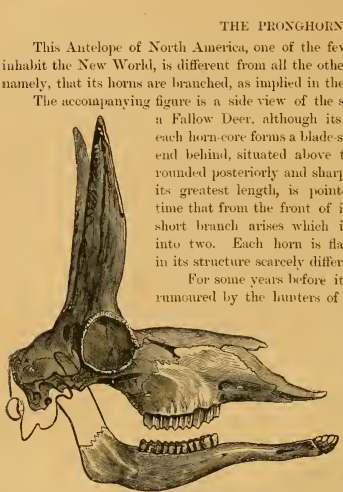
in which the hair is yellowish-red instead of nearly black or brown, the short horns being, as well, directed considerably upwards instead of directly outwards.

In the Island of Celebes the smallest species of Buffalo is found, which differs but little in appearance from the young of the Cape species. It is known as the ANOA; is black, with short, wavy hair, and has short, parallel prismatic horns directed upwards from the forehead.

THE PRONGHORN ANTELOPE.*

This Antelope of North America, one of the few forms of the Hollow-horned Ruminants which inhabit the New World, is different from all the other members of the group in two respects at least, namely, that its horns are branched, as implied in the name, and that they are annually shed.

The accompanying figure is a side view of the skull of the animal, whose size is nearly that of a Fallow Deer, although its build is not so heavy. It is there seen that each horn-core forms a blade-shaped projection six inches long, with the pointed end behind, situated above the eyes perpendicular to the line of the face, rounded posteriorly and sharpened in front. Each horn itself is a foot or so in its greatest length, is pointed and gently curved backwards, at the same time that from the front of it, very slightly above the middle of its height, a short branch arises which is directed forwards, the whole there dividing into two. Each horn is flattened from side to side, is not annulated, and in its structure scarcely differs from that of a Sheep or Goat.



SKULL OF THE PRONGHORN ANTELOPE.

For some years before it was certainly known to be the case, it had been rumoured by the hunters of Fort Union that the Pronghorn Antelope shed its horns each year; and in the year 1858 Dr. C. A. Canfield, of Monterey, California, in writing to Professor Baird, of the Smithsonian Institution, Washington, informed him that in specimens in his possession "their horns drop off annually." This letter remained unprinted until in England Mr. A. D. Bartlett, Superintendent of the Zoological Gardens in Regent's Park, London, in 1865 drew attention to the same fact, which was observed by him in a male animal living in the Gardens at the time.

The horns—not antlers, be it noticed—are, it is now certain, detached each year from their supporting cores, and subsequently dropped, to be replaced by others which at the time of shedding have already advanced some way in growth, although at first they are very pale and soft. In this respect the Pronghorn is not resembled by any other Antelope, and differs entirely from the Deer.

Of the species Dr. Canfield, in the letter above referred to, gives several interesting details as to its habits, from which we may infer that they are not so cunning or so fleet as their allies in Africa and India:—"From the 1st of September to the 1st of March they run in bands, the bucks, does, and kids all together," shortly after which time the young are born, upon which the bucks separate and wander about alone until the following season. "A band of Pronghorn Antelopes, when frightened, never run directly away from you, but cross over in front of you, running across your path from one side to the other repeatedly, and keeping about a hundred yards ahead. On this account it is sometimes easy, on a smart Horse, to run into a drove of them and catch one of them with a noose. When one is alone, and is watched by a person or animal and becomes frightened, it makes a sort of shrill blowing noise like a whistle, and then commences bounding off. On the neck it has a heavy, thick, chestnut-coloured mane, five or six inches long, and on the rump a white patch of coarse hair; and when the animal is frightened it always erects the mane and the hair and this white spot, thus giving it a very singular and characteristic appearance as it runs bounding away

* *Antilocapra americana.*

PRONGHORN ANTELOPE.

from you. The Antelope has a very peculiar odour, strong and, to some people, offensive. . . On the whole, I consider the meat of the Pronghorn to be very excellent."

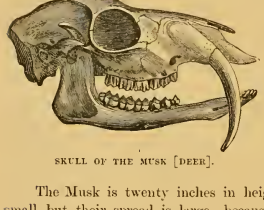
There is a peculiarity in the feet of the Pronghorn in which it resembles the Giraffe, a few Antelopes, and the different members of the Camel tribe, namely, that the false hoofs, as well as their supporting bones, are entirely absent, from which it may be inferred, as is the case, that the number of digits in each foot is only two.

In the females of the species the horns are present, but they are much reduced in size, and almost hidden in the hairy covering of the head. The end of the nose—in other words, the muffle—is hairy, and not, therefore, damp at all times in any part, as is that of the Ox and most ruminants. The tail is very short; the fur is very short and close set, being stiff and wavy. Its colour is a pale fawn above and on the limbs, whilst the breast as well as the abdomen are a yellowish-white, at the same time that the tail and round about it are pure white, as is the inside of the ear.

Although the Pronghorn is here described after all the more ordinary hollow-horned Ruminantia, it is far from impossible that it is much more intimately related to some one of the above-mentioned families than to the others. It must either have originated direct from the earliest type of Bovine Ruminant, and from that time continued isolated until the present day, or it may have been a straggler from some already differentiated group, like the Gazelles, for instance, that, arriving in a land so unlike the haunts of its progenitors, took on itself from altered circumstances peculiar modifications in its horn-growth and foot-form which have resulted in its present characteristics.

THE MUSK [DEER].*

This interesting animal, from the male of which is obtained a powder contained in a pouch about the size of an orange, on the surface of the abdomen, and which is one of the most fragrant of perfumes, is generally included among the Cervidæ. Nevertheless, there are many reasons in favour of its being considered an Antelopine animal. Apart from the fact that it has a gall-bladder, which is not found in any Deer, but in almost all Antelopes, its pale grey hair is peculiarly coarse and Goat-like, and the absence of antlers or horns in both sexes tells in neither direction, for, as in the Brockets of South America and the Chinese Muntjac, the antlers are rudimentary, so are the horns in the Bush-bucks of Africa, and in some domestic Sheep as well as Oxen.



SKULL OF THE MUSK [DEER].

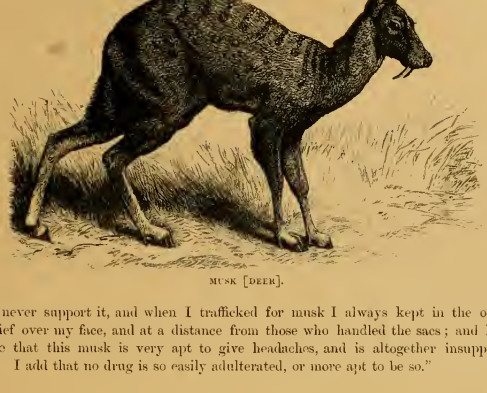
The presence of enormous canine tusks, three inches long, would at first sight seem to be in favour of its relations with the Deer, because in the Muntjacs they are also found. Nevertheless there is no *à priori* reason why these formidable weapons should not be developed in a hollow-horned ruminant: for, cropping up independently in genera so distant as the Deerlets, the Muntjacs, and the Water Deer, why should they not do so in the Antelopes as well?

The Musk is twenty inches in height, its ears large, and its tail rudimentary. Its hoofs are small, but their spread is large, because of the yielding attachment of the false hoofs, as in the Reindeer. The coarse and brittle hair is grey and slightly brindled. Its habitat is Central Asia, from the Himalaya Mountains to Pekin, at elevations above 8,000 feet.

"The Musk Deer," according to Captain Kinloch, "is a solitary and retiring animal; it is nearly nocturnal in its habits, remaining concealed in some thick bush during the daytime, and only coming out to feed in the mornings and evenings. It frequents the highest parts of the forest, preferring the birch, rhododendron, and juniper, and is almost always found alone, rarely in pairs, and never in flocks. No animal seems more indifferent to cold, from which it is well protected by its thick coat of hollow hair, which forms as it were a sort of cushion, which acts as an insulator, and enables the Deer to lie even on snow without much loss of animal heat. It is amazingly active and sure-footed, bounding along without hesitation over the steepest and most dangerous ground. Its usual food seems to be leaves and flowers, but the natives say that it will kill and eat Snakes."

* *Moschus moschiferus.*

The value of the Musk perfume causes the animal to be persecuted beyond measure. From Chardin we learn that the hunters are obliged to cover the nose and mouth with linen when removing the scent-sac, to prevent pulmonary haemorrhage. "I have," says he, "gained accurate information respecting this circumstance, and as I have heard the same thing talked of by some Armenians who had been to Boutan, I think that it is true. The odour is so powerful in the East Indies



MUSK [DEER].

that I could never support it, and when I trafficked for musk I always kept in the open air, with a handkerchief over my face, and at a distance from those who handled the sacs; and hence I know by experience that this musk is very apt to give headaches, and is altogether insupportable when quite recent. I add that no drug is so easily adulterated, or more apt to be so."

THE GIRAFFE.*

Apart from its unique proportions and its size, the Giraffe presents peculiarities in its organisation which compel us to separate it from the Deer on the one hand, and the hollow-horned ruminants on the other. In both these groups the appendages on the head, whether developed as antlers or as horns, are distinct prolongations from the forehead bones themselves. In the Giraffe, however, the three bony appendages, one median and two lateral, all covered with skin, instead of being produced as outgrowths from any portion of the skull, are separate and independent conical bony "processes" which stand upon the skull, capping roughened conical prominences destined to support them. Neither are horns, like those of Sheep or Oxen, nor antlers like those of the Deer, ever found upon these processes, a tuft of hair alone surmounting the lateral pair.

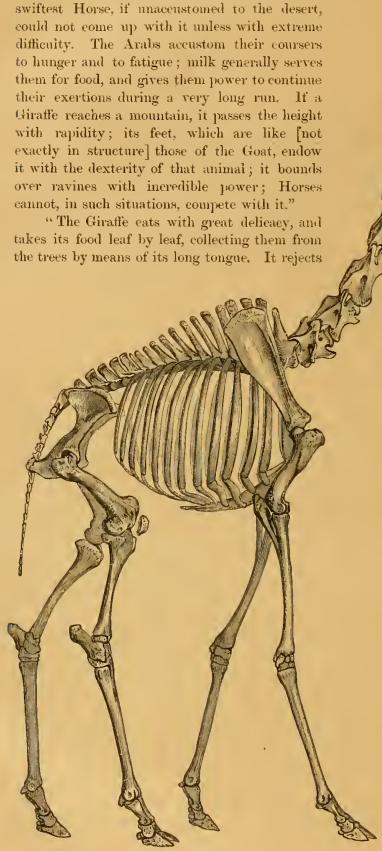
The neck of the Giraffe is longer than that of any other living animal, notwithstanding which it conforms to what, on account of its almost constant applicability, may be termed a law, namely, that there are but seven vertebræ which go to form the neck of a mammalian animal. In this animal, such being the case, each vertebra is very long, which makes the neck correspondingly awkward and inflexible; so that when the head is much carried to the side, the conformation and enumeration of the bones in the cervical region is not a matter of any difficulty.

The Giraffe is a native of Africa south of the Sahara. Most of the specimens which reach Europe in a living state are brought from Nubia and the north-east of the continent generally. The adult male attains a height of sixteen feet, the female rarely exceeding fourteen feet. They live and have bred well in captivity, although, as may be readily imagined, they are most delicate, and require much special care, particularly to prevent the joints of their lengthy limbs from being injured.

* *Camelopardalis giraffa.*

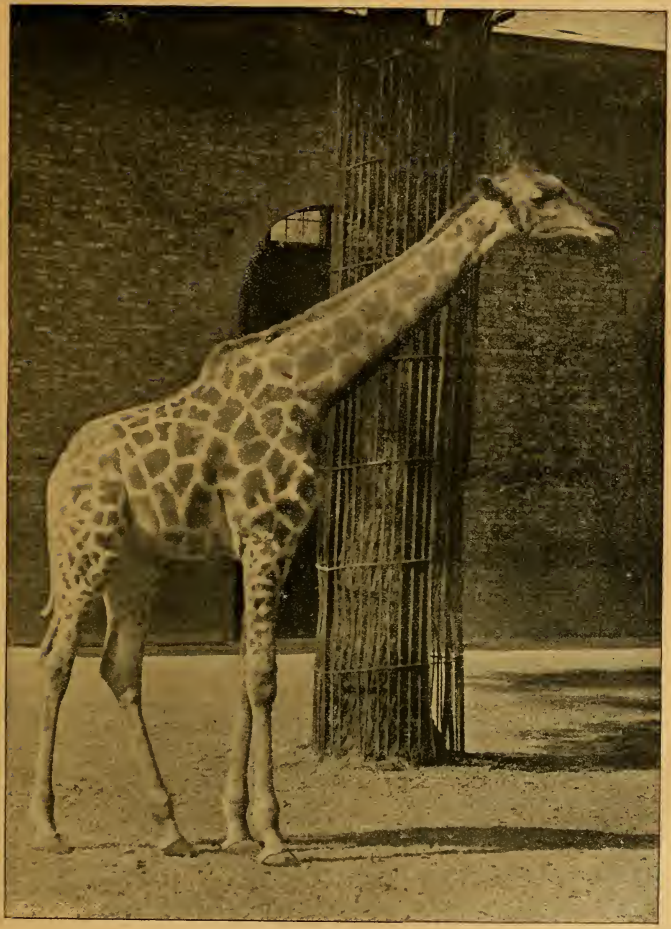
M. Thibaut, who, in 1836, obtained the first specimen of the Giraffe alive for the Zoological Gardens in Regent's Park, tells us that "the first run of the Giraffe is exceedingly rapid. The swiftest Horse, if unaccustomed to the desert, could not come up with it unless with extreme difficulty. The Arabs accustom their coursers to hunger and to fatigue; milk generally serves them for food, and gives them power to continue their exertions during a very long run. If a Giraffe reaches a mountain, it passes the height with rapidity; its feet, which are like [not exactly in structure] those of the Goat, endow it with the dexterity of that animal; it bounds over ravines with incredible power; Horses cannot, in such situations, compete with it."

"The Giraffe eats with great delicacy, and takes its food leaf by leaf, collecting them from the trees by means of its long tongue. It rejects the thorns, and in this respect differs from the Camel. . . . It is extremely fond of society, and is very sensible. I have observed one of them shed tears when it no longer saw its companions or the persons who were in the habit of attending it."



SKELETON OF THE GIRAFFE.

By Le Vaillant and other sportsmen most graphic accounts have been given of the hunting of the Giraffe. Quoting from Captain Harris, we learn that "the rapidity with which the awkwardly-formed animals can move is beyond all things surprising, our best Horses being unable to close with them under two miles. Their gallop is a succession of jumping strides, the fore and hind leg on the same side moving together instead of diagonally, as in most other quadrupeds; the former being kept close together, and the latter so wide apart, that in riding by the animal's side the hoof may be seen striking on the outside of the Horse, threatening momentarily to overthrow him. Their motion, altogether, reminded me rather of the pitching of a ship or rolling of a rocking-horse, than of anything living; and the remarkable gait is rendered still more automaton-like by the switching, at regular intervals, of the long black tail, which is invariably curled above the back, and by the corresponding action of the neck, swinging as it does like a pendulum, and literally imparting to the animal the appearance of a piece of machinery in motion. Naturally gentle, timid, and peaceable, the unfortunate Giraffe has no means of protecting itself but with its heels; but even when hemmed into a corner, it seldom resorts to this mode of defence."



GIRAFFE.

(*From the Living Specimen in the Zoological Gardens, London.*)

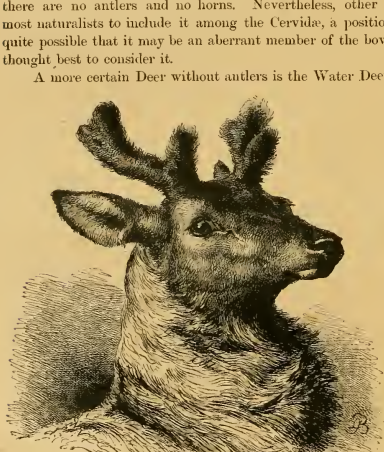
CHAPTER IV.

THE CERVIDÆ, OR ANTLERED RUMINANTS: THE ELK, ELAPHINE, SUB-ELAPHINE, AND RUSINE DEER.

The Deer Tribe—Distinguishing Characters—Exceptions to the rule—The Musk (Deer) and Chinese Water Deer—Other Characters of the Cervidæ—Antlers, their Nature, Growth, and Shedding—The Knob—"Velvet"—Getting rid of the "Velvet"—Full equipment—Contests—Interlocking Antlers—Distribution—Classification—Development of Antlers in the Common RED DEER—Explanation of the various stages—Splendid "Heads"—Simple and Complex Antlers—Types of Antlers—THE ELK, OR MOOSE DEER—Appearance—Antlers—Habits—Hunting—THE ELAPHINE DEER—THE RED DEER—Distribution—Appearance—Hunting—THE WAPITI—Acting of the Fawns—THE PERSIAN DEER, OR MARÂL—THE CASHMERIAN DEER, OR BARASINGHA—Habits and General Appearance—BARBARY DEER—SUB-ELAPHINE DEER—THE JAPANESE, FORMOSAN, AND MANTCHURIAN DEER—THE FALLOW DEER—Peculiarity of its Antlers—THE PERSIAN FALLOW DEER—THE RUSINE DEER—THE SAMBUR, OR GEROW—Habits—Species of Java, Formosa, Sumatra, Borneo, Timor, Ternate, and the Philippines—THE HOG DEER—THE AXIS DEER—PRINCE ALFRED'S DEER—THE SWAMP DEER—SCHOMBURGK'S DEER—ELD'S DEER, OR THE THAMYN—Description—Habits—Hunting—Shameful havoc.

THE Deer tribe, known scientifically as that of the CERVIDÆ, is more circumscribed, and therefore better defined, than are the BOVIDÆ, or hollow-horned ruminants. Their best distinguishing character is that in the males there is each year developed a pair of antlers which is shed at the end of the season to be reproduced in the following spring. The females do not carry antlers, except in the case of the Reindeer, in which, although these elegant appendages are of the same form as in their mates, they are constructed upon a much smaller scale. There are, however, one or two Deer in which not even the males carry antlers, and these are the only members of the family with reference to which there is any serious doubt on the subject of affinity. The Musk (*Moschus moschiferus*) may be taken as an example. In this pretty creature, which is more fully described on pages 42—3, there are no antlers and no horns. Nevertheless, other peculiarities in its organisation have led most naturalists to include it among the Cervidæ, a position which is, however, so doubtful that it is quite possible that it may be an aberrant member of the bovine section, as we have for several reasons thought best to consider it.

A more certain Deer without antlers is the Water Deer of China, the flesh of which has formed an article of food among the natives of Shanghai for years. This small Deer has lengthy tusks, as has the Musk Deer, and nearly every member of the family in which the antlers are diminutive. Its very existence was not known in Great Britain until the year 1862, when Mr. Swinhoe, then our consul at Shanghai, described it, which shows how ignorant we still may be of the creatures which inhabit the mighty Celestial Empire.



HEAD OF RED DEER, IN WHICH THE GROWING ANTLERS ARE SEEN COVERED WITH "VELVET."

In most other respects the Deer closely resemble the hollow-horned ruminants. Their complicated stomach does not differ from that of the Ox, and their other organs are constructed upon the same plan, except the liver, which, like that of the Giraffe, lacks a gall-bladder, this reservoir being present in nearly all the Bovidæ. Their general proportions are also much the same. The Red Deer and the Fallow Deer are those best known to most of us, as both are to be found living in Great Britain, as is the Roebuck in the north of Scotland.

The nature, growth, and shedding of the antlers deserve special consideration. In the commencement of the spring a pair of knobs is to be seen upon the forehead of the adult male animal. This is

covered with a nearly smooth dark skin; and a scar can be detected in the middle of each, which is that left by the antler of the year before, where it fell off.

As the weather becomes more propitious these knobs commence to grow, feel warm to the touch, and are evidently filled with actively-circulating blood, supplied by special vessels which are developed at the time. They do not increase regularly in all directions, for if they did the antler would be a sphere, but they sprout out, as it may be termed, around the above-mentioned scar; in most cases there being one branch which takes a direction forward, whilst a second larger one makes its way backward. These become, in the fully-formed antler, the brow antler and the main beam; and it is by other branches growing upon the beam, according to definite laws, different in different species, that the elaborate complications of the fully-developed structure are produced.

As long as the antler, which is composed of genuine bone of very dense texture, is increasing in size, it will be found to be covered with the same warm black skin as is the knob from which it sprang; and as this skin is covered with short, fine, close-set hair, it has received the name of the "velvet." It is this "velvet" which secretes the bony texture of the antler from its inner surface, just in the same way that the outer covering (the periosteum) of any long bone of the body is mainly concerned in the formation of the bone itself. As, also, in the same way, if we seriously graze our shins, and scrape off this covering, the bone exposed is very apt to die, so in the Deer any mishap to the "velvet" injures the growth of the antler in the part affected. The animals, therefore, during the time they are "in velvet" are more than usually careful to protect their cranial appendages, and are inoffensive even to strangers.

HEAD OF RED DEER, IN WHICH THE ANTLER IS FULLY DEVELOPED AND THE "VELVET" HAS DISAPPEARED.

When their antler-growth has ceased their natures change. The "velvet" has performed its function and dries into a parchment-looking membrane, to get rid of which the Deer adopt a very simple method. They rub their antlers against any neighbouring trees, and force them into the soft earth until there is none left, and the bare bone, with scarcely any trace of hollow in the middle of it, is completely exposed. Now, in the glory of their full equipment, they go in search of others of their kind, having previously maintained a comparative solitude. They try their strength by butting at imaginary enemies, and choose their wives, unless prevented by others of their species mightier than themselves, with whom, if fairly matched, they enter into the most formidable contests, to win or to be driven from the herd with ignominy. During these contests the sound of their battering antlers may be heard for considerable distances, whilst now and then, by accident, they interlock themselves inextricably, and perish both, as is attested by skulls so found, and to be seen in more than one museum.

Looking upon the Deer generally, we find them inhabiting many parts of the world—Europe,

Asia, and America. In Africa none occur south of the Sahara, they being there replaced by members of the Bovine section of the order. None are found in Australia, and in America they are far less common than in Great Britain. To understand the peculiar features and the distribution of the various species, it is necessary to classify them in groups of kindred genera, most falling into sections which are distinguishable without difficulty.

In arranging the different members of the Deer-tribe for description, there are peculiarities in their outward conformation which agree with those internal differences upon which all correct notions of relationship alone can be established. In classifying animals, naturalists must always be guided by the totality of the structure of each member of each group; but, as in describing them to those who have not made the minute details of their organisation their special study it is impossible to lay stress on all the various parts which have to be included by the student in arriving at the desired result, those outward features only can be mentioned which are found to tally with their total structure, namely, their osteology, their visceral anatomy, and their muscular arrangement. As an example of the relative importance of different external structures, we may mention that the late Dr. J. E. Gray, in his Catalogue of the Ruminant Mammalia in the British Museum, gives the following arrangement of the genera, in which the length of the tail suggests one distribution of them, whilst the shape of the antlers is in favour of another, which is very different :—

1.—*Tail very short or clubbed.*		2.—*Tail elongate, with longer hair at the end.*
Red Deer and its near allies.	Antlers claphine	Mantchurian Deer Japanese Deer. Fallow Deer.
Eld's Deer. Barasingha Deer. Schomburgk's Deer. Sambur and its near allies.	Antlers rusine	Hog Deer. Spotted Axis.
Roebuck. Chinese Elaphure.	Antlers capreoline.	

This table is useful as a means of comparing the tails of the different genera; but other points of structure do not in the least support the classification suggested by that appendage, as a result of which it has to be ignored in the consideration of distant affinities, although, where questions of specific proximity are concerned, it is found to be of considerable value.

The antlers render much more trustworthy information in the determination and expression of relationships; and their characterising features can be most readily grasped by having an ideal type in the mind wherewith to compare all aberrant and complicated specimens. This ideal type may be derived in one or other of two ways. The first of these is from the study of the antlers as they are each year developed in any given kind of Deer, commencing with its earliest age. For example, in the Common Red Deer: in the spring of the year following its birth the antlers are nothing more than straight, conical, and unbranched "beams," the animal being then known as a "Brocket." In the following spring the antler has, besides the "beam," a small branch from its base, directed forwards, known as the "brow antler;" it is then termed "Spayad." In the third year an extra front branch is formed, known as the "tres," and the whole antler is larger. This "tres" is sometimes seen in the smaller antler of the Spayad. In the fourth year the brow-antler is doubled, to form the "brow" and "bez-tyne," at the same time that the top of the main beam divides into the "sur-royals" of the "Staggard," or four-year male. In the fifth year the sur-royals become more numerous, the whole antler of the "Stag" being heavier than previously, only to be exceeded in weight by those of the fully adult "Great Hart," with ten or more "points," each being larger and longer than the year before. In Great Britain the conditions of life and the food are not of the quality which develops first-rate antlers, at the same time that it is—in Scotland, at least—the habit to shoot those with the finest heads, and so leave the indifferent specimens to perpetuate their species. In some of the ancient forests of Germany superb heads of the Red Deer are to be obtained, whilst in several of the old castles of that country antler trophies are preserved as memorials of sport in times gone by, with as many as six-and-sixty points. Lord Powerscourt has in his possession a pair with five-and-forty tynes.

The second way is from the study of the antlers of the species in which they are simple, in

comparison with those in which they are particularly complex, both methods as they ought to do, leading to the same result. There are Deer—as, for example, the American Brockets, David's Deer, and Reeves' Muntjac—in which the antler is never more than a simple dag, like that of the "Brocket" stage in the Red Deer. There are others with never more than a single tyne besides the beam, as instances of which may be mentioned the Indian Muntjac and the Huamel. Others, again—and these form an important section of the family—are triply branched, as in the Spayad, the beam bifurcating some distance above the brow-antler. As instances of these we find the Sambur Deer of India, with its large and thus simple antlers; the closely-allied Javan and Swinhoe's Deer; the Spotted Axis; the Hog Deer, and the Roebuck.

We have now arrived at the stage in which the beam has bifurcated, and almost all the more elaborate forms result from an excess in the development of both, or one or other, of the limbs of this bifurcation. In the Deer known as Elaphine—because they more or less resemble the Red Deer (*Cervus elaphus*)—the front of these two branches (the "tres") does not increase or become complicated, whilst from the much-enlarged hind one the numerous sur-royals spring in the biggest species, such as the Wapiti, Cashmere, Red, and Barbary Deer, as well as the Maŭl, of Persia. In the smaller species which follow this type of structure the sur-royals are less developed, at the same time that the brow-antler does not split in two to form a "bez" as well, examples of which are to be seen in the Mantchurian, Formosan, and Japanese Deer, as well as in the Fallow Deer and its newly-discovered ally from Mesopotamia. These two last-named differ also in the "palmation" of their antlers—a peculiarity referred to further in the special description of the species.

VARIOUS TYPES OF ANTLERS.
(From the *Proceedings of the Zoological Society.*)

The accompanying outline diagram represents the most important types of antlers, to one or other of which those of almost every known Deer can be referred. To facilitate future description, they may be named as follows:—

Fig. 1.—Rusine type.
2.—Normal Rucervine type.
3.—Intermediate Rucervine type.
4.—Extreme Rucervine type.
5.—Sub-elaphine type.
6.—Elaphine type.
(A) Brow-tyne. (B) Tres-tyne. (C) Royal-tyne.

The Rusine type (1), in which the brow-tyne (A) is simple, at the same time that the beam ends in a simple bifurcation, is found in the Sambur Deer (*Rusa Aristotelis*) of India. The Rucervine type, in which the bifurcate beam is further subdivided, tends to be prolonged in the direction of the tres-tyne (B), at the same time that there is a corresponding reduction of the royal (C). In Schomburgk's Deer (*Rucervus Schomburgki*) of Siam, both branches of the beam are equally developed (2); in the Swamp Deer (*Rucervus Duvaucelli*) of India (3), the tres (B) is larger than the royal (C); whilst in Eld's Deer (*Rucervus Eldi*) (4), of Burmah, there is but a small snag (C) at the back of the enormous tres-tyne (B) to represent the royal. The Red Deer (*Cervus elaphus*) (6), besides having the brow-tyne (A) re-duplicated, has the royal (C) developed at the expense of the tres (B), and much divided up in well-grown animals. In the Japanese Deer (*Cervus sika*) (5) and its allies the relative proportions of the tynes are much the same, although the brow-tyne (A) is simple.

THE ELK, OR MOOSE DEER.*

The Elk, the largest of the family of the *Cervidæ*, is found in North America, Northern Europe, and the coldest parts of Asia, thinly scattered in all but the first-named locality. At the

* *Alces machlis.*

ELK HUNT.

shoulder it may attain so great a height as eight feet when adult. The female is antler-less. In the male these appendages possess quite a peculiar shape, the two together forming a kind of basin,

YOUNG ELK.

on account of their being developed into huge palmated concave sheets of bony tissue, which diverge laterally from the skull.

At nine months old the antlers first appear, not being more than straight and rounded dags in the first year. They reach their full length in the fifth year, from which period for many more years they increase in breadth and weight, and add, it is said, a fresh point to their palmated margins until the fourteenth, when the creature is considered quite adult.

The colour of the animal is a deep blackish-brown; the neck is short and thick, with a peculiar bob-shaped, pendulous, and hair-covered lap of skin hanging down from its middle, just behind the angles of the jaw. The limbs, especially the front ones, are long; the tail is rudimentary. The coat is formed of close-set harsh angular hair, which breaks when bent, produced into a mane upon the neck and shoulders. Sir John Richardson gives the following account of the habits and food of the Elk, with the mode of hunting it:—"In the more northern parts the Moose Deer is quite a solitary animal, more than one being very seldom seen at a time, unless during the rutting season or when the female is accompanied by her fawns. It has the sense of hearing in very great perfection, and is the most shy and wary of all the Deer species, and on this account the art of Moose-hunting is looked upon as the greatest of an Indian's acquirements, particularly by the Crees, who take to themselves the credit of being able to instruct the hunters of every other tribe. The skill of a Moose hunter is most tried in the early part of the winter; for during the summer the Moose, as well as other animals, are so much tormented by Mosquitoes that they become regardless of the approach of man. In the winter the hunter tracks the Moose by its footmarks in the snow, and it is necessary that he should keep constantly to leeward of the chase, and make his advance with the utmost caution, for the rustling of a withered leaf or the cracking of a rotten twig is sufficient to alarm the watchful beast. The difficulty of approach is increased by a habit which the Moose Deer has of making daily a sharp turn in its route, and choosing a place of repose so near some part of its path that it can hear the least noise made by one that attempts to track it. To avoid this, the judicious hunter, instead of walking in the animal's footsteps, forms his judgment from the appearance of the country of the direction it is likely to have taken, and makes a circuit to leeward until he again finds the track. This manœuvre is repeated until he discovers by the softness of the snow, in the footmarks and other signs, that he is very near the chase. He then disencumbers himself of everything that might embarrass his motions, and makes his approach in the most cautious manner. If he gets close to the animal's lair without being seen, it is usual for him to break a small twig, which, alarming the Moose, it instantly starts up, but not fully aware of the danger, squats on its hams and waits a minute before setting off. In this posture it presents the fairest mark, and the hunter's shot seldom fails to take effect in a mortal part. In the rutting season the bucks lay aside their timidity, and attack every animal that comes in their way, and even conquer their fear of man himself. The hunter then brings them within gunshot by scraping on the blade-bone of a Deer, and by whistling, which, deceiving the male, he blindly hastens to the spot to assail his supposed rival. If the hunter fails in giving it a mortal wound as it approaches, he shelters himself from its fury behind a tree, and I have heard of several instances in which the enraged animal has completely stripped the bark from the trunk of a large tree by striking with its fore-feet. In the spring time, when the snow is very deep, the hunters frequently run down the Moose on snow-shoes, which give them immense advantage, because the slender legs of the animal sink into the snow for their whole length each step they take, which makes their progress very slow."

The usual pace of the Moose is a high shambling trot, and its strides are immense. On account of their necks being short at the same time that their legs are long, they browse upon the bushes rather than on the ground, which they find difficulty in reaching with their mouths.

THE ELAPHINE DEER.*

This group is characterised by the presence of a bez-tyne in all its members—except that under the influence of protracted bad nutrition individuals resident in barren parts may lose it—whilst the tres-tyne is small, and the third main branch of the antler splits up into several snags, sometimes arranged in the form of a cup. The deep brown coat is varied by a conspicuous light, almost white patch upon the rump, in which the uncovered rudiment of a tail is included. All the species are large, the best known to us being

THE RED DEER.†

This species is a native of the British Isles and many parts of Europe. Northern specimens

* The restricted genus *Cervus*. † *Cervus elaphus*.

RED DEER.

are much the smaller, and carry far inferior antlers, those of South Germany and Hungary possessing heads worthy of the species. In England they are still to be found wild in Exmoor Forest, in Scotland north of the Forth and Clyde; and in Ireland about Killarney, Connemara, and Erris.

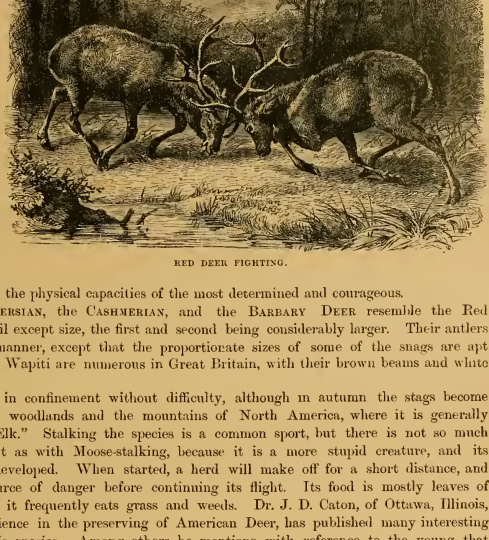
A well-grown Stag stands over four feet at the withers, with a thickly-coated neck of a greyish tint, a rich red-brown body-colour, uniformly curved symmetrical antlers, and head held

RED DEER AND FALLOW DEER IN WINTER.

high. The Stag in summer is a lordly creature. In winter its coat is longer and of a greyer tint. As is the case in allied species, and all but a few of the Rusine Deer, the new-born calves are brilliantly spotted with white.

The pairing season occupies the early part of October. The calves are born at the end of May or the beginning of June; whilst the Stags drop their antlers between the end of February and the earlier days of April, the youngest latest. Up till the age of twelve the animal continues to increase in bulk and strength, and it is highly probable that they do not ever much outlive twenty years, although superstition credits them with very many more.

It is towards the end of August or the beginning of September that the well-nourished Stags, having already cleared their antlers of their "velvet," leave their retirement, and with swollen necks as well as restless mien, seek out the hinds. During the rutting season, which lasts about three weeks, they eat but little, and lose weight rapidly, to be regained in the subsequent repose upon the summer-developed foliage. In the southern counties of Great Britain the hunting of the Stag has degenerated into the repeated chase of a few individuals, deprived of their antlers, and let out of boxes shortly before the sportsmen put in an appearance; whilst long-ranged rifles have reduced the difficulties of what not many years ago—more especially in Scotland—was a form of sport which very severely taxed the physical capacities of the most determined and courageous.



RED DEER FIGHTING.

The Wapiti, the Persian, the Cashmerian, and the Barbary Deer resemble the Red Deer in almost every detail except size, the first and second being considerably larger. Their antlers all branch in the same manner, except that the proportionate sizes of some of the snags are apt to vary. Superb heads of Wapiti are numerous in Great Britain, with their brown beams and white burnished tips.

The Wapiti is kept in confinement without difficulty, although in autumn the stags become savage. Its home is the woodlands and the mountains of North America, where it is generally incorrectly called the "Elk." Stalking the species is a common sport, but there is not so much interest associated with it as with Moose-stalking, because it is a more stupid creature, and its senses are less acutely developed. When started, a herd will make off for a short distance, and stop to recognise the source of danger before continuing its flight. Its food is mostly leaves of trees and shrubs, though it frequently eats grass and weeds. Dr. J. D. Caton, of Ottawa, Illinois, who has had much experience in the preserving of American Deer, has published many interesting details with regard to this species. Among others he mentions, with reference to the young, that "the most prominent instinct of the young fawn is that of deception. I have several times come across fawns evidently but a few hours old, left by the mother in supposed security. They affect death to perfection, only they forget to shut their eyes. They lie without a motion, and if you pick them up they are as limp as a wet rag, the head and limbs hanging down without the least muscular action, the bright eye fairly sparkling all the time." The venison is excellent; it is said to be more nutritious than any other meat.

The Persian Deer, or Marāl, differs from the Cashmerian Deer but little. Its head, however, is longer and more pointed.

The Cashmerian Deer, or Barasingha, again, is hardly distinguishable from the Wapiti. Professor Leith Adams remarks, with reference to it, that "the Cashmere forests seem the head-quarters of this species on the western ranges, for it is seldom, if ever, met with between Mussouree and the Vale of Cashmere. The dense forests and fertile valleys of the latter country are particularly inviting to this species. In habits and general appearance the Cashmere Stag bears a striking resemblance to the Red Deer. Although it is seldom, nowadays, that individuals of the latter species escape

the hunter so long as to attain the size and magnitude of the Barasingha [twelve points], yet I think it will be found that the horns of those killed in the forests of Scotland in former years are equal in size to any at present met with in Cashmere. It is in the dense pine forests on the Northern Pinjal, and in the many beautiful valleys among these ranges, that we find the species most abundant. There are very few on the southern ranges. In the secluded depths of these solitudes they lie all day, to issue forth at dusk and feed on the grassy hill-sides, or descend even into the Valley of Cashmere when forced by the snows of winter. An adult Stag averages thirteen hands in height.

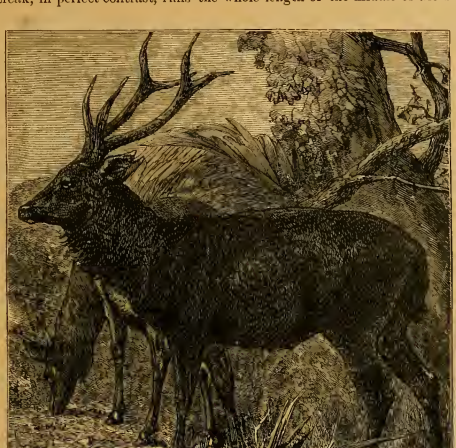
FALLOW DEER.

The colour of the coat varies but little in the sexes or the seasons of the year; dark liver-colour, with reddish patches on the inner sides of the hips; belly and lower parts white, or a dirty white. The male has the hair on the lower part of the neck long and shaggy (wanting in the female); the horns large, and usually very massive, with from ten to fifteen or more points, according to age (the largest pair of horns I have measured were four feet round the curves, with six and seven points). They are shed in March; and the new horn is not completely formed until the end of October, when the rutting season commences, and the loud bellowings of the Stags are heard all over the mountains. During vigorous winters they are frequently driven to seek for shelter and food around the villages in the valleys, when many are destroyed by natives, who hunt them with Dogs. The Cheetahs, Wild Dogs, and Bears are said to kill the young."

The very similar Barbary Deer is most interesting, in that it is the only member of the Cervine group which is found in Africa.

THE SUB-ELAPHINE DEER.*

The Japanese, Formosan, and Mantchurian Deer are all species allied to those just described, but differing in being smaller in size, at the same time that the antlers conform to the sub-elaphine type, in which the bez-tyne is never present, and the sur-royals are but inconsiderably branched. They are all strongly spotted in their summer dress, which, especially in the Mantchurian—the largest of the species—is most brilliant. In the winter their coats are nearly uniform, and of a dark brown colour. A fawn-red is the groundwork of the summer coat, the spots being yellowish-white, whilst a black streak, in perfect contrast, runs the whole length of the middle of the back, continuing



SAMBUR DEER.

down the tail and expanding slightly at its base. The throat is white. The sombre winter coat is a nearly uniform dark red-brown.

The Fallow Deer (*Dama vulgaris*), so well known on account of its being preserved in a semi-domesticated state in so many English parks, has antlers constructed upon the same plan as those of the Mantchurian Deer (sub-elaphine). These, however, present special peculiarities found in none of the allied species, for they are palmated in their upper parts, in the region of the sur-royals, the digitations or terminal points being developed along the convex posterior margins of the palmated surface. The buck is about three feet high at the shoulder. The head is short and broad, the tail between seven and eight inches long. The colour of the wild animal, both buck and doe, is a rich yellowish-brown in summer, spotted with white all over. In winter the tints are more sombre and greyish. Domestic varieties vary immensely, both in the distinctness of the spotting and the general colouration. Until six years of age the buck receives a separate name each year from sportsmen

* The genera *Pseudaxis* and *Dama*.

—fawn, pricket, sorrel, soare, buck of the first lead, and buck complete, being the terms employed—the antlers not being developed at all in the fawn, being simple snags in the pricket, with two front branches in the sorrel, with slight palmation of the extremity of the beam in the soare, and the whole antler larger and larger until the sixth year. The venison of the Fallow Deer is fatter than that of the Red Deer, and is preferred by most.

The species is not a native of Britain, having most certainly been introduced, although exactly

BORNEO RUSINE DEER.

when is not known. The dark-coloured and more hardy breed was brought from Norway by James I. Its true wild habitat was probably the shores of the Mediterranean Sea, both north and south.

The PERSIAN FALLOW DEER,* so closely related to the species just referred to that they breed together, was made known to us in 1875 by Sir Victor Brooke, who described it from specimens sent to England by Mr. Robertson, the British Vice-Consul at Busrah. It resembles the Common Fallow Deer in almost every detail, except that it is slightly larger, and that the antlers are not the same. As stated above, in the Common Fallow Deer the antlers, whilst developed on the sub-elaphine type, are palmated in the region of the royals, with several snags projecting from the upper margin, at the same time that the lower portion of the beam, the tres, and the brow-tynes are cylindrical, as usually is the case in other species.

* *Dama mesopotamica.*

AXIS DEER.

In the Persian Fallow the palmation at the extremity of the antlers is much less conspicuous, and scarcely exists, although many snags are present there, directed upwards. The palmation is at the bases of the antlers instead, including the brow-tyne and the beam, so that the general appearance of the antlers is quite peculiar to the species.

THE RUSINE DEER.*

The SAMBUR, OR GEROW (*Rusa Aristotelis*), of India, is found abundantly in all the hill-districts of that country. It is nearly five feet high, of a deep brown colour, with the hair of the neck developed almost into a mane. The tail is of fair length. Its build is massive, as are its antlers, which present three powerful points, and reach over three feet in length. Above the considerable brow-tyne the beam bifurcates high up into two fairly equal snags, and no more in well-grown antlers. The hind is much less massive, and of a yellowish tint. Captain Kinloch says of the species that "Sambur delight in stony hills, where there is plenty of cover, and where they can have easy access to water. They browse more than graze, and are nearly nocturnal in their habits. During the daytime they seek the most shady retreats, and old Stags especially are most difficult to find, frequently betaking themselves to almost inaccessible places, where the uninitiated would never dream of looking for them. The experienced hunter, indeed, has frequently to depend more upon fortune than his own knowledge of woodcraft." In Java an almost identical species differs mostly in having the hinder of the two branches of the beam of the antler longer than the one in front. Swinhoe's Deer from Formosa is also almost indistinguishable, at the same time that Sumatran and Bornean specimens agree with it in being particularly dark in colour.

Three smaller species, with antlers branched in exactly the same manner, are found in the islands of Borneo, Timor, Ternate, and the Philippines.

The HOG DEER of India and Ceylon is not bigger than the Roebuck although the legs are shorter and the body heavier. Its antlers consist of a brow-tyne and bifurcate beam, of which the posterior tyne is short, and turned inwards; they rarely exceed a foot and a half in length. It is of a uniform dark brown colour, rarely spotted indistinctly with white. Their name is derived from the pig-like way in which they run, with their heads low, when pursued.

The SPOTTED HOG DEER is a rare species, of a slightly lighter colour, and with pale yellow spots.

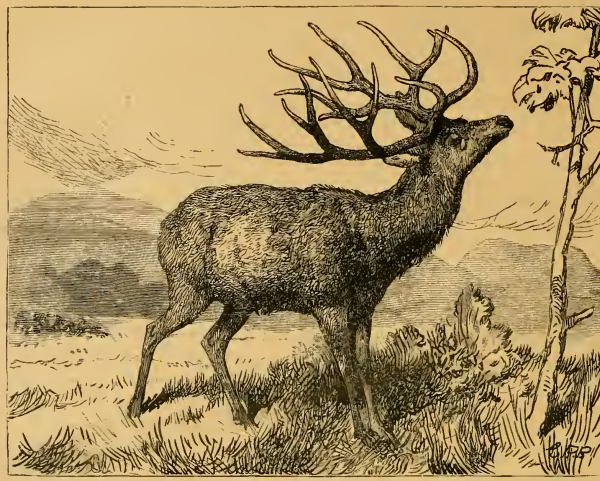
The AXIS DEER of India, sometimes called the Cheetal, resembles the Fallow Deer in size and colouration most closely, although its antlers serve to show that its true relations are quite different. These latter are not palmated at all, and are quite rusine in type, presenting the three points characteristic of them, the front tyne of the bifurcate beam being of great length. There is a beauty in the intensity of the spotting of the coat of this species which is unequalled by any other member of the Cervidæ, and it is interesting to know that according to the universal testimony of sportsmen, the effect of sunlight through foliage so much resembles it that it is almost impossible to recognise the animal in the woods. They have a reputation for being indolent, as they feed during the night, and sleep throughout the day, frequenting the heavy grass-jungles along the banks of rivers. Their cry is a shrill bark at the approach of danger. The accompanying figure (see Plate 26), drawn from a specimen in captivity, gives an excellent idea of the immense length attained by the antlers, which in this particular case are blunt-tipped, because not quite fully grown. The hinder tyne on the right side, it will be noticed, is almost entirely hidden in the hair of the flank.

PRINCE ALFRED'S DEER,† about the size of the Fallow Deer, was first described by Dr. Sclater from a specimen brought from the Philippine Islands by the Duke of Edinburgh in 1870. Its glossy coat is of a rich chocolate colour, covered with pale yellow spots; a broad line along the back, as in all spotted Deer, being uninterrupted; the under parts are of a pale yellow. The antlers are only nine inches in length, but comparatively thick, and simply branched upon the rusine type, with three points. The legs are rather short, at the same time that the body is heavy.

The SWAMP DEER.‡ The name Barasingha, signifying "twelve points," is applied to two very different species of Indian Deer, the Cashmerian Deer, previously mentioned, and the Swamp Deer.

The Swamp Deer of India and Assam is slightly smaller than the Sambur, not exceeding four

* The genus *Rusa* and its allies. † *Rusa Alfredi.* ‡ *Rucervus Duvaucelli.*



SCHOMBURGK'S DEER.

feet in height. Its colour is a rich light yellow. As its name signifies it delights in moist situations, where it congregates in herds of great numbers. Its antlers are large, and of the intermediate rucervine type. The brow-tynes reach a foot in length, and are directed forwards with an upward turn at their tips. The beam is long, and branches into an anterior, massive, and branched continuation of itself, as well as a posterior smaller bifurcate tyne.

In Siam this species is replaced by the closely-allied SCHOMBURGK'S DEER, a little-known species, in which the antlers are extremely elegant, the long brow-tyne being followed by a short beam which bifurcates into two equal branches, these again, each of them, bifurcating in a similar manner.

ELD'S DEER, OR THE THAMYN.* This Deer, which differs from the Swamp Deer only in its antlers, was discovered by Captain Eld, in 1838. It abounds in the swamp lands of Burmah, and extends as far east as the Island of Hainan. Its form is slimmer than that of the Red Deer, at the same time that it is somewhat smaller, attaining a height of over four feet. During the summer months its body-colour is a light rufous brown, with a few faint indications of white spots. Its under parts are nearly white, as are the insides of the hairy ears. Its tail is short, and black above. In winter its lengthy hair takes on a darker tint.

Lieutenant R. C. Beavan has given an excellent account of the habits of Eld's Deer, from which we learn that their food must consist almost entirely of grass and paddy, which grow both cultivated and wild, in the swamps in which they dwell. "In habits they are very wary and difficult of approach, especially the males. They are also very timid, and easily startled; the males, however, when wounded and brought to bay with Dogs, get very savage and charge vigorously. On being disturbed they invariably make for the open, instead of resorting to the heavy jungle like Hog Deer and Sambur. In fact the Thamyn is essentially a plain-loving species; and, although it will frequent tolerably open tree-jungle for the sake of its shade, it will never venture into dense or matted

* *Rucervus Eldi.*

underwood. . . . When first started the pace of the Thamyn is great. It commences by giving three or four large bounds like the Axis or Spotted Deer, and afterwards settles down into a long trot, which it will keep up for six or seven miles on end when frequently disturbed." As to the means employed to hunt them, the same author informs us that "a large number of men would assemble from the neighbouring villages, and gradually encircle three or four moderate-sized herds with long strings, upon which plantain-leaves were tied so as to flutter in the wind. The circle, originally formed at some distance, was gradually lessened as the Deer, afraid to pass the scarecrows, got gradually driven together, until they were completely surrounded and at the mercy of the hunters. The object was to get them into a corner near the heavy jungle, into which, if they attempted to run, they either became entangled, or allowed their pursuers to get up quite close. As many as a hundred and fifty to two hundred, my informant tells me, he has himself seen killed in one battue in former years. To such a length was this [shameful] system carried, and such enormous havoc was thereby created, that the Burmese Government, fearing the species would be utterly exterminated, wisely put a stop to the practice."

CHAPTER V.

THE MUNTJACS—THE ROEBUCK—CHINESE DEER—REINDEER—AMERICAN DEER—DEERLETS—CAMEL TRIBE—LLAMAS.

THE MUNTJACS—Distribution—Characters—THE INDIAN MUNTJAC, OR KIDANG—Hunting—THE CHINESE MUNTJAC—Habits—DAVID'S MUNTJAC—"Shanyang"—THE ROEBUCK—THE CHINESE WATER DEER—Peculiarity—Chinese Superstition regarding it—THE CHINESE ELAPHURE—Peculiarity of its Antlers—THE REINDEER—Distribution—Character—Colouration—Antlers—Canadian Breeds—Food—THE AMERICAN DEER—THE VIRGINIAN DEER—THE MULE DEER—THE BLACK-TAILED DEER—THE GUAZUS—THE BROCKETS—THE VENADA, OR PUDU DEER—THE CHEVROTAINS, OR DEERLETS—Antlerless—Their Position—Bones of their Feet—General Form and Proportions—Species—THE MEMINNA, OR INDIAN DEERLET—THE JAVAN DEERLET—THE KANCHIL—THE STANLEYAN DEERLET—THE WATER DEERLET—THE CAMEL TRIBE—Their Feet—Stomach—Its Peculiarity—The Water Cells—THE (TRUE) CAMEL—Description—The Pads of Hardened Skin—Its Endurance—Its Disposition—Anecdote of its Revengeful Nature—THE BACTRIAN CAMEL—THE LLAMAS—Description—Habits—Used as Beasts of Burden—Wild and Domesticated Species—THE HUANACO—THE LLAMA—THE VICUNA—THE ALPACA—The Alpaca Industry—FOSSIL RUMINANTIA—Strata in which they are found—*Cheropotemus*—*Hyopotamus*—*Dichobune*—*Xiphodon*—*Cainotherium*—*Oreodon*—*Sivatherium*—Fossil Deer, Oxen, Goats, Sheep, Camels, Llamas, Antelopes, Giraffes—The Irish Elk—Its huge Antlers—Its Skeleton—Ally—Distribution.

THE MUNTJACS.*

THE Muntjacs form a group of small and elegant Deer found in India, Burmah, China, the Malay Peninsula, and the large islands of the Indo-Malay Archipelago. They differ from all other members of the family in that their diminutive antlers are supported on lengthy bony pedestals, covered with a hairy skin much like the horn-processes of the Giraffe. Most, also, have a pair of elongated longitudinal ridges between the eyes, within the folds of which small glands are situated, at the same time that there is a dark crest of retroverted hair, tending to the shape of a horseshoe, upon the forehead. In the males the upper canine teeth develop into tusks, which project externally some way below the lip, though not so far as in the Musk, forming efficient instruments of attack.

The INDIAN MUNTJAC, OR KIDANG, is the best known species. Its antlers attain a larger size than those of any of the others, although they are not more than four inches long, composed of an undivided beam, at the base of which there is a diminutive brow-tyne. Its size is slightly less than that of the Roebuck, its colour uniformly foxy red-brown, with the throat, hind part of abdomen, and under surface of tail white. A black line runs up the inner side of each antler-pedestal of the male, instead of forming the frontal horseshoe of the female.

Dr. Horsfield tells us that in Java, where it is much hunted, "the Muntjac selects for its retreat

* The genus *Cervulus*.

certain districts, to which it forms a peculiar attachment, and which it never voluntarily deserts. Many of these are known as the favourite resort of the animal for several generations. They consist of moderately elevated grounds, diversified by ridges and valleys, tending towards the acclivities of the more considerable mountains, or approaching the confines of extensive forests. . . . . The Muntjac has a strong scent, and is easily tracked by Dogs. When pursued it does not go off, like the Stag, in any accidental direction; its flight, indeed, is very swift at first, but it soon relaxes, and taking a circular course, returns to the spot from which it was started. After several circular returns, if the pursuit be continued, the Kidang thrusts its head into a thicket, and in this situation remains fixed and motionless, as if in a place of security, and regardless of the approach of the sportsman."

In China the Muntjacs are smaller than those of India and Java; their antlers are less

INDIAN MUNTJAC.

developed at the same time that the tint of their coats is less rufous, and the neck is not white. They were first described by Mr. Ogilby under the name of Reeves' Muntjac, a larger form having been more recently discovered by M. A. Milne-Edwards and Mr. Swinhoe. With reference to its habits the last-named naturalist tells us that "this species affects the low ranges of hills which are covered with long, coarse grass and tangled thicket. It is there usually found in small herds, basking in the sun, or lying in hidden lairs. They are very seldom approached near, except by stealth. The least noise startles them, and they dash away with bounds through the yielding grass, occasionally showing their rounded backs above the herbage. They have, however, their regular creeps and passes through the covert, near which the natives lie when stalking them, while others drive them. The little startled creatures hurry from danger along these beaten tracks, and are then picked off with the matchlock." In captivity they soon become very docile, even when taken in the adult state. The flesh of this animal is very tender and palatable.

The enterprising missionary Père David, among his numerous discoveries in Chinese zoology, sent from Moupin, in Western China, to Paris, skins of a peculiar Muntjac, which is of special interest. Having canine tusks, a black frontal hairy horseshoe, and the proportions of a Muntjac generally, its antlers are not more than an inch long, at the same time that their pedestals are

correspondingly reduced in length as well as thickness. Its body-colour is mouse-brown, verging on grey, whilst the hairy covering is coarse. It may be called David's Muntjac.

Very shortly after the above-mentioned skins arrived at Paris, Mr. Michie, of Shanghai, forwarded to Mr. Swinhoe in England another specimen from Ningpo, which, although derived so far east of Moupin, is almost indistinguishable from that belonging to the latter district. The animal is there known as the "Shanyang," or Wild Goat. It is an undoubted Muntjac, although peculiar in not possessing the glands on the forehead found in the more common species.

THE ROEBUCK.*

This elegant, small, and almost tailless Deer is, like the Red Deer, a native of Great Britain, as well as of all Northern Europe and Asia below the line of perpetual snow. In Asia the individuals attain a greater size than in Europe. The adult Roebuck stands a little over two feet high

ROEBUCK: MALE, FEMALE, AND YOUNG.

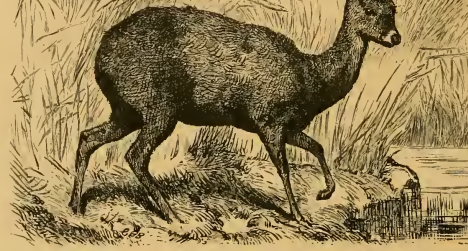
at the shoulder. Its colour is a dark reddish-brown in summer, becoming yellowish-grey in the cold weather. There is a large patch of white on the rump. The antlers, which are peculiarly near together at their bases, rarely exceed a foot in length, possessing three points, the rugose unbranched beam continuing from the considerable burr for half a foot unbranched; then bifurcating fore and aft, the posterior branch again bifurcating. The destruction of the forests throughout Britain has driven the Roebuck farther north, till now it is most common in the north of Scotland, although it still survives in the woods of Westmoreland and Cumberland. Its disposition is wild, shy, and cautious. Its favourite resort is the thick underwood of forests, living singly or in small companies of a pair with their young, which latter—contrary to what we find in the case of most other Deer—are two or three in number. Its venison makes very indifferent food.

THE CHINESE WATER DEER.†

This is an entirely isolated small species, not bigger than an Indian Muntjac, discovered by Mr. Swinhoe, *in which there are no antlers*, the canine teeth of the upper jaw being developed into immense tusks which project downwards, as in the Musk and Muntjacs. The legs are short, and

* *Capreolus caprea.* † *Hydropotes inermis.*

the body lengthy. The body-colour is a light red-brown all over. There is no tuft of hair on the head as in the Muntjacs, to which by some it might be imagined to be allied. From Mr. Swinhoe's account of the species we learn that "In the large riverine islands of the Yangtsze, above Chinkiang, these animals occur in large numbers, living among the tall rushes that are there grown for thatching and other purposes. The rushes are cut down in the spring; and the Deer then swim away to the main shore and retire to the cover of the hills. . . . Fortunately for the Deer, the Chinese have an extraordinary dislike for their flesh. I could not ascertain why; but it must be from some strange superstition, as the Celestials are otherwise pretty omnivorous. The Deer are killed only for the European markets [of Shanghai], and sold at a low price. Their venison is coarse, and without much taste. . . . . The Chinese at Shanghai call this animal the *Ke*, but at Chinkiang they are named *Chang*—the classical term for the Muntjac."



CHINESE WATER DEER.

THE CHINESE ELAPHURE.*

This most interesting Deer was discovered in 1865 by the indefatigable French naturalist, M. Armand David. In his account of the animal, Dr. Sclater† tells us that M. David first observed it whilst looking over the wall of the Imperial Hunting-park at Pekin, to which no European is allowed admission. There it is found in a semi-domesticated state, its native place probably being Eastern Mantchuria. In 1869, Sir Rutherford Alcock succeeded in sending a living pair to England, which were exhibited for some time in the London Zoological Gardens, and from which much information has been obtained with reference to their habits. It resembles the Swamp Deer of India (*Rucervus Duvaucelli*) in its proportions and size, standing nearly four feet at the shoulder. The legs are somewhat heavy and the feet expanded, but it is in its antlers that the Elaphure is quite different from any other Deer. They are represented in the accompanying engraving, from which the abrupt ascent of the beam, with an enormous back-tyne arising from the lower end, and no brow-tyne, may be most clearly seen. The beam branches higher up, but its furcations follow none of the ordinary rules of cervine antler-growth.

The body-colour of the animal is light and rufous, paler on the under parts. A black line runs some way down the back, being most conspicuous at the shoulders. The tail is not longer than in the Fallow Deer, and is hairy at the tip. Mr. Swinhoe tells us that the Chinese name is Sze-poo-seang, which signifies "like none of the four"—to wit, the Horse, the Cow, the Deer, or the Goat.

* *Elaphurus Davidianus.* † *Transactions of the Zoological Society*, Vol. VII. p. 333.

CHINESE ELAPHURE.

THE REINDEER.*

The Reindeer, which differs from all its allies in that the females carry antlers as well as the males, forms so important an element in the social economy of the Laplanders that more has been written on its habits than of any other species of the family. It is found distributed throughout the Arctic regions of Europe, Asia, and America, extending farther south in the last-named of these in the same way as the isothermal line of 32° Fahr., as might be expected from the relation borne by its economy to its temperature. In Spitzbergen, Finland, and Lapland it attains the

REINDEER AT A LAPP ENCAMPMENT.

greatest size, being inferior in strength and stature in Norway and Sweden. In Iceland it has been introduced and thrives. The Caribou is the name by which it goes in the New World, where it extends through Greenland, Canada, and Newfoundland. The horns of the American variety differ from those of the Old World so much that it is not difficult to recognise their origin; nevertheless, attempts which have been made to establish the specific difference of the two forms have not found much favour with naturalists generally.

The animal, with a characteristic deer-like form, is powerfully built, with short limbs and heavy neck. The feet have the false hoofs well developed, while the fissure between the median toes is so much extended upwards, and the ligaments which bind them together are so loose, that their hoofs spread out considerably when pressed upon the ground, and so increase the surface for support upon the yielding snow—their most frequent foothold. Upon raising the limbs in rapid action these hoofs make a sharp snap at the moment when they close together.

* *Rangifer tarandus.*

REINDEER.

Individuals vary much in tint as well as with the season. Some are entirely white, whilst in winter the coat is always lighter than in summer. Deep brown is the prevailing tint, and there is generally a band of white above each hoof. As in the Elk—another Arctic ruminating animal—the muffle of the nose is covered with hair, and is not moist. The fur is of two sorts—an outer covering of longer, harsh, brittle hair, and an under-coat of closely-matted and much finer, wool-like texture, which serves as an excellent protection against the inclement temperature, and makes the skins so valuable for articles of clothing in the Arctic regions.

The antlers are strikingly large for the size of their owners. Although they vary considerably in detail, the general plan of their construction is always the same, agreeing with that of the Virginian Deer and the Barasingha. As in the Wapiti and Red Deer, the brow-antlers on each side are, however, re-duplicated, so that a bez is present. This, as well as the brow-tyne, is branched, or palmated, wherein it is peculiar; and further, in the Caribous one of the brow-tynes is generally aborted, in order to allow of the great development of its fellow of the opposite side into a palmated triangle, flattened from side to side, directed straight forward in the middle line of the head, and attached by its apex to the beam. The function of this share-like expansion in the economy of the animal can hardly be other than to remove the snow which covers its favourite food, each movement of the lowered head from side to side effecting this result. The beam is lengthy, curved boldly upwards and forwards, with a small snag at the back, about half-way from each end. Its extremity is branched and often palmated, much like the horns of the Fallow Deer. The beam may reach a length not more than three inches less than five feet. In the females the same plan of structure of the antlers exists as in the males. They are considerably smaller in every respect, more slender, and scarcely palmated, if at all so.

The Woodland Caribou and the Barren-ground Caribou are the names given to a larger and a smaller breed in Canada. Both are hunted by the Indians for their flesh as well as for their hides, the venison obtained from the latter being held in high estimation. The pounded meat, when mixed with melted fat, is known as pemmican. The tongue is esteemed a great delicacy.

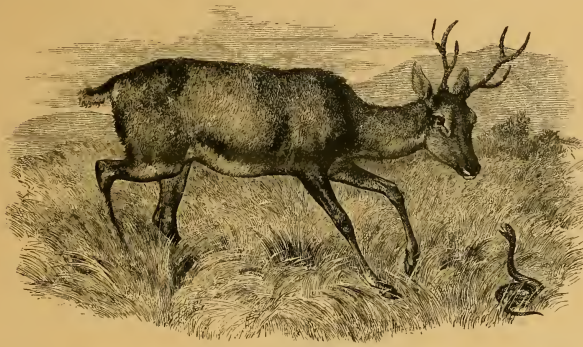
The Reindeer, from the nature of the country it inhabits, is compelled to lead a migratory life, in which the natives of Lapland, who have to depend entirely for their sustenance on the animal, have to participate. Troops of them during the winter months reside in the woods, feeding on the lichens that depend from boughs of the trees, as well as on those that grow upon the ground beneath. In the spring they repair to the mountains in order to escape the swarms of stinging Gnats and Gad-flies which infest the air, and inflict wounds in the skin of most serious severity.

THE AMERICAN DEER.

In America there are several species of Deer which differ considerably from those of the Old World. In our remarks on these animals we will not include among them the Wapiti and the Elk: the Wapiti, because it is nothing but a large representative of the Red Deer of Great Britain; the Elk, because it stands very much by itself, at the same time that it is found in the Arctic Old World as well as in America. We ourselves think that the Reindeer conforms to the American type of structure, and have therefore described it in relation with the New World Deer, although most authors class it not far from the Elk.

None of the typical Deer of America attain any considerable size, and their antlers are decidedly small when contrasted with those of the Old World. The species which will be first described is the VIRGINIAN DEER, which is the "Common" Deer of North America, and is slightly smaller than the Fallow Deer. Its colour is uniform, being of a reddish-yellow in summer and light grey in winter. The individual members of the species are small in Mexico, and get larger as they live more north. The antlers belong to the extreme rucervine type, their beams turning outwards and forwards in a very characteristic manner, with several points directed upwards from their convex border. The brow-tyne is short and pointed upwards instead of forwards. The tail is nearly a foot and a half in length. In disposition it is timid and wild, and is therefore domesticated with difficulty. Its flesh was in times gone by one of the staple articles of food of the aborigines. Audubon and other authors have described in detail the various modes employed in capturing these Deer, including the "still hunt," "jack hunt," "fire hunt," &c., according to the nature of the country.

The Mule Deer and the Black-tailed Deer are not far distantly related North American species. The former is slightly larger than the Virginian and of a heavier build. Its tail is short, tufted, and white; its colour a dark grey in winter, dull yellow in summer. Its name was suggested from its lengthy ears. The latter is smaller, and has shorter legs. Its colour is tawny grey, the short tail black above and white below. Of both these species the antlers differ from the Virginian Deer in detail, only the brow tyne of the Black-tailed species being rudimentary, at the same time that the snags on the convex margin of the beam spring from a single stem instead of independently. In the Mule Deer they are smaller and less branched. Lord Walsingham, in writing of them, remarks, "They appear to frequent the thick willow clumps and other brushwood bordering the streams and swamps. They were extremely difficult to distinguish among the foliage, and remarkably quick when alarmed. As they bound off over logs and fallen trees, or dash through the thicket, they have a habit of swinging their broad white tails with a conspicuous flourish, which becomes annoying to a sportsman, to whom they never afford anything but a snap shot, which is very apt to fail."



GUAZUTI DEER.

The Guazus are small South American Deer with large ears and short tails, in which the antlers want the brow tyne, and have the beam branched in almost exactly the same way as Schomburgk's Deer when not quite full grown. The Guazuti, one of them, is not more than two feet six inches in height.

The Brockets are equally small, with minute antlers of a most simple form—whence the name—they being unbranched and shelving backwards. The colour of the fur in the Guava Viva and Brazilian Brocket is pale brown, and shining red-brown in the Red Brocket and the Eyebrowed Brocket.

The Venada, or Pudu Deer, is not bigger than Reeves' Muntjac or a Hare. Its colour is red-brown, and it has minute antlers, not far separated from one another. It inhabits the western coast of South America.

THE CHEVROTAINS, OR DEERLETS.*

It is not until within the last few years that naturalists have separated off from the true Deer a group of diminutive animals which look like them in miniature, but are entirely destitute of antlers. These little creatures, known as Chevrotains, for which we take the liberty of coining the name Deerlets, were placed together with the Musk into a single section, characterised by the fact that the males possess large tusks situated in the upper jaw, which project downwards, and are conspicuous even when the mouth is fully closed, grooving the lower lip on each side. Now,

* *Tragulidæ.*

however, they are entirely separated off from the Deer and Ox tribes, to constitute an independent family, because of the peculiarities of many of their parts. They have a complex stomach composed of paunch, honeycomb-bag, and reed, the manyplies being so much reduced in size, that it may practically be said not to be present.

From the bones of their feet it is evident, too, that they cannot be correctly classed with the more ordinary Ruminants, and that they tend towards the other family of the Cloven-hoofed Ungulata, namely, the Swine. Each foot of the common Pig possesses four toes, that corresponding to our thumb in the fore-limb, and to our great toe in the hind being absent, as has been previously explained. The bones of all these toes are quite separate from one another, as in those of man, at the same time that those of the outer and inner digits in each limb are smaller than those which bear the larger hoofs. In the true Ruminants and in the Camel tribe these larger toes are partly fused together, the bones of digit three and digit four corresponding to those situated in the human palm and sole, being joined from end to end to form the "cannon-bone;" whilst those of digit two and

JAVAN DEERLET.

digit five are reduced to mere imperfect splinters, or are sometimes altogether lost, as in the Giraffe and in the Camel. Now, in the Deerlets, these bones are not blended at all in the fore-limbs of the Water Deerlet of West Africa, in which, as in all the other species, digit two and digit five are perfect from end to end. They therefore stand, in this respect, as in others easily explained, intermediate between the Swine and the true Ruminants.

All the Deerlets are particularly delicate, diminutive, and graceful animals, the slenderness and clear-cut outline of their limbs being exceedingly striking. With bodies as big as that of a Hare or Rabbit, their legs are not so thick as a cedar pen-holder or a clay pipe-stem. Their proportions are very much those of the small Water Bucks of Africa, and of many of the kinds of Deer, especially the Hog Deer of India, in which the body, as in them, is not carried very high above the ground. The want of antlers in both sexes makes them resemble Hinds rather than Stags at first sight, whilst their elegantly-pointed noses, and large dark eyes, add to their general interesting appearance.

Of the Deerlets there are five species—the Meminna, the Kanchil, the Javan, the Stanleyan, and the Water Deerlets. The first four are confined to India, Ceylon, Malacca, Java, and Sumatra, the last being found in Sierra Leone and the Gambia district. These differ slightly in their size and markings, the MEMINNA, or INDIAN DEERLET, being nearly eighteen inches long, and about eight inches high at the shoulder, the tail being very short. As in its allies, the white spotting of the surface is disturbed by two or more streaks of the same which run along the flanks.

The JAVAN DEERLET, known sometimes as the Napu, is smaller than the preceding. It is of

a rust-brown colour above and white beneath, three white stripes radiating backwards, one along the middle line, and the other two laterally from the front of the neck. The short tail is white-tipped. The naked and moist muzzle is black. The Javan Deerlet is gentle in disposition, and somewhat uninteresting in captivity. Specimens are frequently brought to Great Britain, and live if carefully protected from the cold.

The KANCHIL is still smaller in size, at the same time that it is darker in colour, especially along the back. Its activity and cunning are remarkable, so much so that Sir Stamford Raffles, in his original description of the creature, tells us that it is a common Malay expression, with reference to a great rogue, that he is "as cunning as a Kanchil." Feigning to be dead when caught, its captor incautiously releases his hold, when the animal is immediately up and away before any means can

STANLEYAN DEERLET.

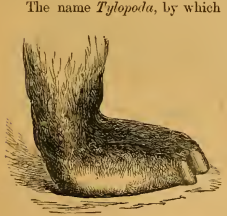
be employed for its recapture. It is also said that when pursued by Dogs it will jump up towards a bough, and there hook itself by means of its lengthy tusks until its tormentors have passed under it.

The STANLEYAN DEERLET was named after the grandfather of the present Earl of Derby, in whose menagerie at Knowsley the species was first recognised.

The WATER DEERLET of West Africa is slightly larger than the Meminna. Its deep glossy brown coat is also streaked with white lines, and is irregularly spotted.

THE CAMEL TRIBE, OR TYLOPODA.

The name *Tylopoda*, by which the Camels, together with the Llamas, are known to naturalists, is derived from two Greek words (τύλος, a knot or callus, and ποῦς, a foot), signifying that the feet, instead of being protected by hoofs, are covered with a hardened skin, enclosing the cushion-like soles of the feet, which are so constructed that they spread out laterally when brought in contact with the ground, an arrangement of evident advantage to desert-ranging animals. The tips of each of the two toes are protected by nails, as can be seen in the accompanying drawing.



FOOT OF CAMEL.

There are also other points in which these creatures differ from the more ordinary Ruminantia. In the front of the upper jaw there are two teeth—one on each side, placed laterally—which correspond to the side cutting teeth in man, and to

the similarly-situated "nippers" of the Horse. In the Deer, Ox, Sheep, and their allies there is not a trace of these, as has been previously explained (page 4). As to the limbs, it may also be mentioned that the true knee-joints — which in animals like the Horse are almost entirely hidden within the general skin-covering of the body —are much more conspicuous and free.

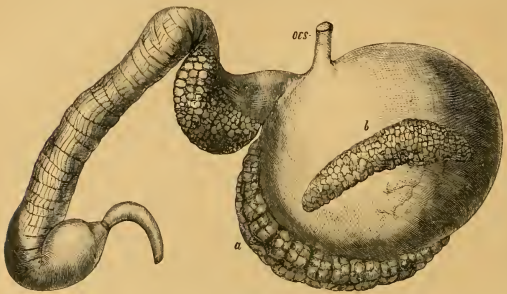


Fig. A.—STOMACH OF THE LLAMA.

The stomach is peculiar; it wants the "many-plies," or third compartment, but possesses the "paunch," "honeycomb-bag," and "abomasum," the last-named of which is of great length. In the walls of the paunch there are present two extensive collections of "water-cells," which serve their owners in good stead whilst traversing the desert or residing in regions where fresh water is not to be procured except with difficulty.

Fig. A is a view of the stomach from below (or, in other words, from the side farthest from the backbone), in which it is seen that the clusters of water-cells (*a* and *b*) are arranged, one (*a*) the larger, along part of the right border of the viscus, whilst the second (*b*) is transverse, the remainder of the walls being smooth. These water-cells, seen from within in Fig. B, are formed by the development of septa, both transverse and longitudinal, in the substance of the paunch-wall. They are deep and narrow, much like the cells of a honeycomb, and have a muscular membrane covering their mouths, in which there is an oval orifice opposite to each compartment capable of being further dilated or completely closed, probably at the will of the animal. When fully distended, these paunch-cells in the Arabian Camel are capable of storing a gallon and a half of water. The second stomach, or reticulum, is also modified in the same direction, the usually extremely shallow cells being deep, at the same time that food is

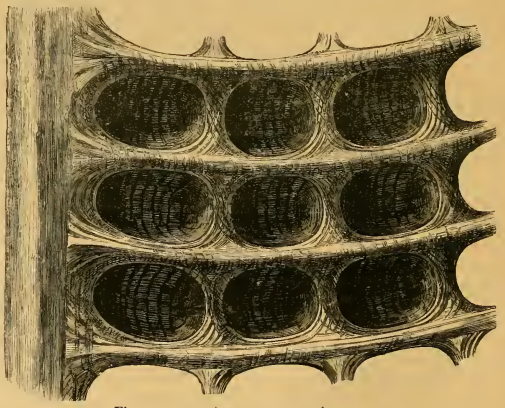


Fig. B.—WATER CELLS OF THE CAMEL'S STOMACH.

never found in them after death. Of the last compartment, or "abomasum," it may be noted that it is nearly cylindrical in shape, its walls being very muscular. It is in this stomach that true digestion is carried on.

Of the Camels two species are known, differing in the number of the humps upon their backs. Nothing is known of either variety in the wild state. We will commence with the description of

THE (TRUE) CAMEL.*

The One-humped Camel of Arabia is frequently termed the Dromedary, but this latter name

HEAD OF THE (TRUE) CAMEL.

is correctly applicable only to the swift variety of the species which is employed for riding, the heavier-built One-humped Pack-Camel not being included under the designation.

It is the Arabian Camel—the *Ship of the Desert*—which is much more serviceable to man than its Bactrian ally. Its distribution has extended westwards along North Africa, from which attempts have been made to introduce it into Spain. Eastwards it is found as far as India.

In the Camel the limbs and neck are lengthy. A single bulky hump is present on the middle of the back, composed of fatty cells held together by strong bands of fibrous tissue which cross in all directions. Like all similar accumulations, it varies much in size according to the condition of the animal, dwindling almost to nothing after protracted hard work and bad feeding, being firm and full in times of ease and plenty. When on the point of commencing a long journey, there

* *Camelus dromedarius.*

is nothing on which an Arab lays so much stress as on the condition of his Camel's hump, which, from what we have just said, must be considered to be nothing more or less than a reserved store of food.

Upon the chest, the elbows, the fore-knees (true wrists), knees, and hocks, callous pads of hardened skin are found, upon which the creature supports its weight whilst kneeling down, a position in which it always rests, and one which it assumes when being loaded. These pads are present in the new-born Camel-calf, proving, contrary to the view maintained by some, that they are not the direct result of pressure, but are special provisions in accordance with the requirements of the species, arrived at by a process of natural selection, those individuals alone surviving in which there is the power of resisting the injurious effects of protracted strain upon a few spots of the skin.

The coat is, in the summer, scanty; in the winter, of considerable length, and matted into lumps. The two-toed feet are very much expanded, and tipped with a pair of small hoofs. The lips are covered with hair, the upper one being split up for some distance in the middle line. The nostrils, when closed, are linear, and from their construction prevent sand from entering the air-passages when the animal desires it. The tail is of fair length, reaching to the ankle-joint. There is a fixity about its attitudes, and a formality about its paces, which is quite characteristic. Its power of enduring fatigue upon its scanty fare, whilst carrying a weight as great as 600 lbs., together with its endurance, makes it invaluable in its desert home.

A stolid obstinacy is its usual disposition. Mr. Palgrave, criticising the reputation that the animal has for docility, remarks:—"If docile means stupid, well and good; in such a case the Camel is the very model of docility. But if the epithet is intended to designate an animal that takes an interest in its rider so far as a beast can; that in some way understands his intentions, or shares them in a subordinate fashion; that obeys from a sort of submissive or half fellow-feeling with his master,

THE (TRUE) CAMEL.

BACTRIAN CAMEL.

like the Horse or Elephant: then I say that the Camel is by no means docile—very much the contrary. He takes no heed of his rider, pays no attention whether he be on his back or not, walks straight on when once set agoing, merely because he is too stupid to turn aside; and then, should some tempting thorn or green branch allure him out of the path, continues to walk on in the new direction simply because he is too dull to turn back into the right road. In a word, he is from first to last an undomesticated and savage animal rendered serviceable by stupidity alone, without much skill on his master's part, and any co-operation on his own, save that of an extreme passiveness. Neither attachment nor even habit impresses him; never tame, though not wide awake enough to be exactly wild."

Nevertheless the animal gives indications of intelligence when badly treated, if we may judge from its revengeful nature, well illustrated in the following account:—

"A valuable Camel, working in an oil-mill, was severely beaten by its driver. Perceiving that the Camel had treasured up the injury, and was only waiting a favourable opportunity for revenge, he kept a strict watch upon the animal. Time passed away; the Camel, perceiving that it was watched, was quiet and obedient, and the driver began to think that the beating was forgotten, when one night, after the lapse of several months, the man was sleeping on a raised platform in the mill, whilst, as is customary, the Camel was stabled in a corner. Happening to awake, the driver observed by the bright moonlight that, when all was quiet, the animal looked cautiously around, rose softly, and stealing towards a spot where a bundle of clothes and a bernous, thrown carelessly on the ground, resembled a sleeping figure, cast itself with violence upon them, rolling with all its weight, and tearing them most viciously with its teeth. Satisfied that its revenge was complete, the Camel was returning to its corner, when the driver sat up and spoke. At the sound of his voice, and perceiving the mistake

it had made, the animal was so mortified at the failure and discovery of its scheme, that it dashed its head against the wall and died on the spot."

THE BACTRIAN CAMEL.*

The Two-humped Camel is found in the regions to the east and north of the home of its One-humped ally, extending as far as Pekin and Lake Baikal. It it a heavier, shorter-legged, and thicker-coated species, at the same time that the feet are more adapted to a less yielding soil from their greater callousness. The hair is specially abundant upon the top of the head, the arm, wrist, throat, and humps. There is no variety of this species corresponding to the Dromedary One-humped Camel.

HUANACO ATTACKED BY A PUMA.

THE LLAMAS.†

The Llamas, when the term is employed in its wider sense, include the American representatives of the Camel tribe, none of which have any trace of the dorsal hump or humps found in their Old World allies. They are mountain animals, found in the Cordilleras of Peru and Chili, in this respect also differing from the desert-loving Camels, with which they agree in all important structural peculiarities, including the stomach, lips, nostrils, and coat. The feet are somewhat modified in accordance with the rocky nature of the mountain regions which they inhabit, the sole-pads being less considerable, and almost completely divided into two hard cushions, with a long and hooked nail in the front of each.

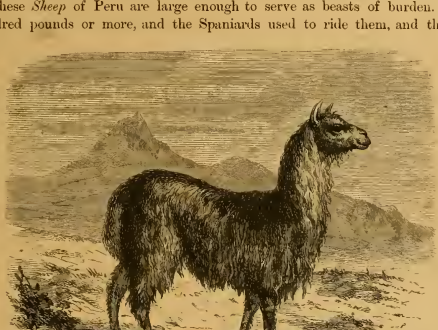
Llamas were found domesticated when South America was first discovered by the Spaniards,

* *Camelus bactrianus.* † *Auchenia.*

BACTRIAN CAMEL.

(*From the Living Specimen in the Zoological Gardens, London.*)

and as there were then no Mules or Horses there, these creatures were employed exclusively as beasts of burden, as well as for their flesh, their wool, and hides. Their disposition and their habits also resemble those of the Camel. They have their own peculiar gait and speed, from which they cannot well be made to vary. When irritated they foam at the mouth and spit, sulking and lying down when overloaded. As beasts of draught their most important use is to convey the ores from the mines of Potosi and elsewhere in the Andean range. From the account of Augustin de Zerate, who was a Peruvian Spanish Government official in the middle of the sixteenth century, we learn that "in places where there is no snow the natives want water, and to supply this deficiency they fill the skins of Sheep [Llamas being meant] with water, and make other living *Sheep* carry them, for it must be remarked that these *Sheep* of Peru are large enough to serve as beasts of burden. They can carry about one hundred pounds or more, and the Spaniards used to ride them, and they would go four



LLAMA.

or five leagues a day. When they are weary they lie down upon the ground, and as there is no means of making them get up, either by beating or assailing them, the load must of necessity be taken off. When there is a man on one of them, if the beast is tired he turns his head round and discharges his saliva, which has an offensive odour, into the rider's face. These animals are of great use and service to their masters, for their wool is very good and fine, particularly that of the breed called Pacas, which have very long fleeces; and the expense of their food is trifling, as a handful of maize suffices them, and they can go four or five days without water. Their flesh is as good as that of the fat Sheep of Castile."

It is somewhat difficult to decide exactly the relations of the wild to the domesticated species of the Llamas. It seems most probable that there are two true species, known as the Huanacos (*Lama huanacos*) and the Vicuna (*Lama vicugna*), of the former of which the true Llama is a domesticated variety, as the Alpaca is of the latter.

The HUANACO—or Guanaco, as it is sometimes written—has a more elongated head and more slender legs than the Vicuna, at the same time that there are elongated warty tubercles upon the hinder limbs not found in the latter species. Its height at the shoulder is three feet and a half. The fur is uniformly brown, at the same time that it is rough and short. It can be domesticated without difficulty. Its tail is short and hairy. Its native haunts are the highlands of Peru and Chili, as well as farther south, where it lives in herds, which descend to the valleys in the winter

months. When hunted they have a habit of now and again facing their pursuers, after which they gallop off afresh. When attacked at close quarters they defend themselves by striking with their fore-feet. From Mr. Darwin's account of the animal in the "Voyage of the *Beagle*," we learn that it "abounds over the whole of the temperate parts of South America, from the wooded islands of Tierra del Fuego, the rough Patagonia, the hilly parts of the La Plata, Chili, even to the Cordillera of Peru. Although preferring an elevated site, it yields in this respect to its near relative the Vicuna; on the plains of Southern Patagonia we saw them in greater numbers than in any other part. Generally they go in small herds, from half a dozen to thirty together, but on the banks of the St. Cruz we saw one herd which must have contained at least five hundred. On the northern shores of the Strait of Magellan they are also very numerous. Generally the Guanacoes are wild and extremely wary. The sportsman frequently receives the first intimation of their presence by hearing from a distance the peculiar shrill neighing note of alarm. If he then looks attentively, he will perhaps see the herd standing in a line on some distant hill. On approaching them, a few more squeals are given, and then off they set at an apparently slow—but really quick—canter along some narrow beaten track to a neighbouring hill. If, however, by chance he should abruptly meet a single animal, or several together, they will generally stand motionless, and intently gaze at him; then, perhaps, move on a few yards, turn round, and look again. What is the cause of this difference in their shyness? Do they mistake a man in the distance for their chief enemy, the Puma, or does curiosity overcome their timidity? That they are curious is certain; for if a person lies on the ground and plays strange antics, such as throwing up his feet in the air, they will almost always approach by degrees to reconnoitre him. . . . On the mountains of Tierra del Fuego, and in other places, I have more than once seen a Guanaco, on being approached, not only neigh and squeal, but prance and leap about in the most ridiculous manner, apparently in defiance as a challenge. . . . The Guanacoes readily take to the water; several times at Port Valdez they were seen swimming from island to island. Byron, in his 'Voyage,' says he saw them drinking salt water. Some of our officers likewise saw a herd drinking the briny fluid from Salina, near Cape Blanca. I imagine, in several parts of the country, if they do not drink salt water they drink, none at all. In the middle of the day they frequently roll in the dust in saucer-shaped hollows. . . . The Guanacoes appear to have favourite spots for dying in. On the banks of the St. Cruz the ground was actually white with bones in certain circumscribed places, which were generally bushy, and all near the river. On one such spot I counted between ten and twenty heads, some gnawed, as if by beasts of prey."

The Domestic Llama resembles its wild ancestor in most respects. Its colour may, however, be variegated, or even white. Its woolly coat is longer, but not so fine, and when it is removed by shearing the animal is conspicuously spotted.

The VICUNA is a smaller animal of a light lion-brown colour, with a short and hairy face; its neck is lengthy, as in its allies; its height about two feet six inches. Its wool is particularly fine, and has been much employed, undyed, as a material for clothing. It is active and spiteful, inhabiting a region higher and therefore colder than the Huanaco.

The Alpaca is its domestic form, with thicker and much darker wool, as well as shorter limbs. Its colour is often nearly black, or black varied with white or brown.

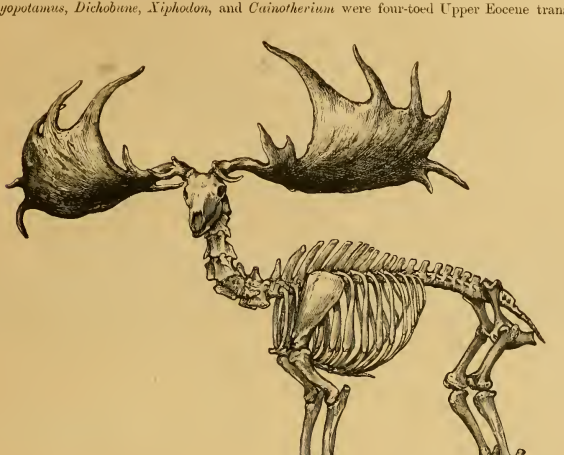
The manufacture of alpaca stuffs dates from the year 1836, when Mr. (afterwards Sir) Titus Salt commenced weaving the unusually long-haired wool, which at the time found no sale in the markets on account of its not being suited to the existing combing apparatus. Since that period alpaca has been much employed as a fabric, possibly to be again replaced in great measure by the sheep wool of the Australian and other British colonies.

FOSSIL RUMINANTIA.

The study of fossil forms throws as much light upon the development of existing types of Ruminantia as it does in the case of the Perissodactyla. Until the last of the three great geologic epochs none have been found; whilst in the Tertiary strata from Eocene, Miocene, and Pliocene formations, numerous species are known, resembling existing types more closely as they are discovered in the more recently deposited strata.

As might be anticipated from what has been said above, and as is indicated in the table of classification of the Artiodactyla on page 336, Vol. II., the oldest forms of cloven-hoofed Mammalia must have been intermediate in structure between the Pigs and Ruminants. Such a creature existed at the close of the Eocene period in *Chæropotamus*, discovered first by the illustrious Cuvier in the palæontologically most interesting gypsum beds at Montmartre. Another specimen has also been found near Ryde, in the Isle of Wight. The creature was pig-like in size, and in the tuberculated structure of its grinders, the parts, together with the lower jaw, alone discovered as yet.

Hyopotamus, *Dichobune*, *Xiphodon*, and *Cainotherium* were four-toed Upper Eocene transitional



SKELETON OF THE IRISH ELK.

forms approaching the Ruminants, but all possessing upper cutting-teeth, the last-named differing but little from the Deerlets. *Oreodon* is a genus of small pig-like animals, appearing first in the Miocene of North America, and evidently closely related to the Ruminantia. *Sivatherium* was a gigantic Ruminant with four horns in pairs, and evidently a trunk. Its remains are found in the Miocene deposits of the Sewalik hills of India. Deer, Oxen, Goats, and Sheep first appeared in the Pliocene period, as did Camels and Llamas. Antelopes and Giraffes existed earlier, namely, in the Late Miocene. It is a fact of interest that Camels are abundant in the Miocene and Pliocene of North America, whilst they are only very scantily distributed in the same strata of the Old World, Arabia and Asia being their sole living habitat.

Among the most interesting of the Pleistocene species which has been discovered in Great Britain is the gigantic Irish deer, a species originally included with the Elk, on account of the palmation and outward inclination of its huge antlers, in some specimens only a few inches less than

eleven feet in span, and each more than five feet long in a straight line from burr to tip. In general form the antlers do not strikingly differ from those of the Common Fallow Deer. The brow-tyne is quite simple at its base, and generally slightly bifid at its extremity, there being no true "bez." The beam is cylindroid as far as the insignificant "trez," beyond which it is flattened out into a gigantic triangular expansion, or "palm," with the free base developed into snags, usually about seven in number, and a fairly independent posterior tyne.

IRISH ELK. (*Restored.*)

At the withers the skeleton, which is quite cervine in every detail, measures as much as six feet; its great peculiarity in the male being the large size of the cervical or neck vertebræ, necessarily extra strong that they may support the massive antlers, about seventy pounds in weight. In the females, which had no cranial appendages, the vertebræ of the neck were one-third smaller

The accompanying figure is an attempt to represent the species under consideration, as it must have appeared when living. It is worthy of note, however, that as the coat of the Fallow Deer, which may be its nearest ally, is brilliantly spotted, the great Irish Deer may have resembled it in that respect.

The first fairly complete skeleton of the species was found in the Isle of Man. Others have been obtained from Waterford and elsewhere in Ireland.

A. H. GARROD.

PRAIRIE DOG.

ORDER RODENTIA.

CHAPTER I.

INTRODUCTION—THE SQUIRREL, MARMOT, ANOMALURE, HAPLODONT, AND BEAVER FAMILIES.

Character of the Order—A well-defined Group—Teeth Evidence—Kinds and Number of Teeth—The Incisors: their Growth, Renewal, and Composition—The Molars—The Gnawing Process—Skeleton—Brain—Senses—Body—Insectivora and Rodentia—Food of Rodents—Classification—THE SIMPLE-TOOTHED RODENTS—Characteristics—THE SQUIRREL-LIKE RODENTS—SCIURIDÆ—Distinctive Features—THE COMMON SQUIRREL—Form—Distribution—Food—Bad Qualities—Habits—THE GREY SQUIRREL—THE FOX SQUIRREL—Flying Squirrels—Their Parachute Membrane—THE TAGUAN—Appearance—Habits—Other Species—THE POLATOUCHE—THE ASSAPAN—The Genus *Xerus*—THE GROUND SQUIRRELS—THE COMMON CHIPMUNK—THE MARMOTS—Distinguishing Features—THE SPERMOPHILES—THE GOPHER—THE SISEL, OR SUSLIK—THE BARKING SQUIRRELS—THE PRAIRIE DOG—Description—Species—Habits—Burrows—Fellow-inmates in their "Villages"—THE TRUE MARMOTS—THE BOBAC—THE ALPINE MARMOT—THE WOODCHUCK—THE HOARY MARMOT, OR WHISTLER—ANOMALURIDÆ—Tail Peculiarity—Distinctive Features—HAPLODONTIDÆ—Description—THE SEWELLEL—CASTORIDÆ—THE BEAVER—Skeletal Peculiarities—General Form—Appearance—Distribution—The Beavers of the Old and New World—Habits—Wonderful Sagacity—The Building Instinct—Their Method of Working—The various Stages—Their Lodges—Their Dams—Activity by Night—Flesh—Hunted—The *Castoreum*.

WHILE the last few chapters have been devoted to orders which contain the largest and most powerful of terrestrial mammalia, we have now to treat of a group, all the members of which are of comparatively small size. "Mice, rats, and such small deer," to use Shakspere's phrase, make up a great proportion of the order Rodentia. The biggest of them is only about the size of a small Pig; and perhaps the common House Rat, or, at any rate, the common Squirrel, may be taken as showing the average dimensions of a Rodent. But, although from this point of view they

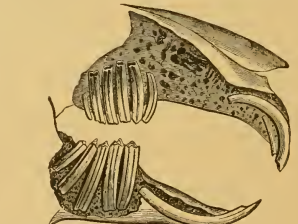
may be looked upon as "a feeble folk," their numerous species render them a most important section of the mammalian fauna of nearly all countries, and this importance is greatly increased, practically, by the immense number of individuals by which each species is usually represented.

SKULL OF THE TAGUAN, A FLYING SQUIRREL.

The Rodentia, or gnawing mammals—GLIRES, as Linnæus and some modern zoologists call them—notwithstanding the great number of the species and the immense variety of forms which they display, constitute, perhaps, the most definitely circumscribed order of the Mammalia. In most other groups of the same value, we find that some types exhibit divergent characters, which render it difficult to frame a general description of the order which shall include them; or else some species present a marked tendency towards some other order; but in the case of the Rodents, we never have any difficulty, a cursory inspection of the dentition is always sufficient to decide whether a quadruped belongs to the Rodentia or not; and in spite of an almost infinite variety of form, the structure of the rest of the organism is most clearly in accordance with the evidence derived from the teeth.

The teeth are only of two kinds—incisors and grinders (*see* the above figure of the skull of the Taguan)—and the number of efficient teeth of the former kind is never more than two in each jaw. Almost throughout the order, indeed, there are actually, even from the first, only two incisors present; but in the Hares and Rabbits, and some allied forms, there are in the upper jaw, in addition to the working teeth, a pair of rudimentary incisors,* placed immediately behind the large ones, but quite incapable of taking any part in the business of gnawing, for which the latter are so admirably fitted. Their presence is, however, of interest, as indicating the direction in which an alliance with other forms of Mammalia more abundantly supplied with teeth is to be sought.

The great incisors, which are characteristic of the Rodents, exhibit the following peculiarities:—They possess no roots, but spring from a permanent pulp, so that they continue growing during the whole life of the animal; and their form, and that of the cavity which constitutes their socket, is always that of a segment of a circle,† in consequence of which, they always protrude from the front of the jaws in the same direction, and meet at the same angle. By this means, as the teeth are worn away at their summits by use in gnawing, a fresh supply of tooth is continually being pushed forward to take the place of the portion thus removed, and, in fact, so intimately are the two functions of use and growth correlated in the teeth of these animals, that if by chance one of the incisors should get broken, or the natural opposition of these teeth should be disturbed in consequence of injury to the jaw, the teeth, thus deprived of their natural check, continue growing, and, following the curve of their sockets, gradually form circular tusks, which must always be greatly in the way of the animal when feeding, and sometimes, by actually penetrating again into the mouth, cause its death by absolute starvation. The teeth themselves are composed of dentine, coated along the front surface with a layer of hard enamel, which substance is wanting on the other surfaces of the teeth, except in the Hares, Rabbits, and other forms with additional rudimentary incisors in the upper jaw, in which, as further evidence of their relationship to the other Mammalia, the whole surface of the incisors is encased in enamel, although this coat is excessively thin except on the front or outer face. The purpose



DENTITION OF THE HARE.

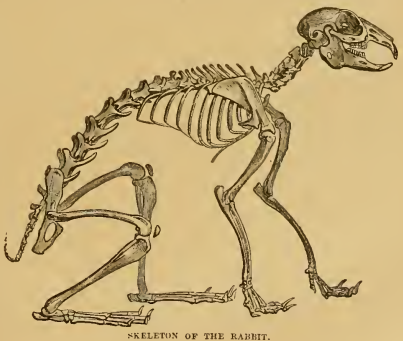
* In the young there are four of these small additional teeth, but the outer pair disappear after a short time.

† The upper teeth always constitute a larger segment of a smaller circle than the lower ones.

of this structure of the incisors is easily understood. In the action of gnawing, the dentine, which forms the greater part of the tooth, is more easily abraded than the harder enamel, which is thus left as a sharp front edge, to which the mass of dentine behind it, being worn away into a bevelled surface, gives the necessary firmness and support, the whole forming a chisel-like instrument, constructed precisely on the principle of those tools in which a thin plate of hard steel forms the cutting edge, and is stiffened by a thicker bevelled plate of softer iron.

The canine teeth are entirely deficient, and behind the incisors we find on each side a toothless gap of considerable extent (*see* figures p. 82), beyond which come the grinding teeth. In these it is difficult to recognise any distinction of molars and pre-molars; the whole series presents nearly the same structural characters, and for all practical purposes we may speak of them as molars, although some zoologists prefer to regard the three hindmost teeth on each side as true molars, and any others that may be present as premolars. In one genus (*Hydromys*) the number of grinding teeth is reduced to two on each side in each jaw; in a great proportion of the species the number is three; others have four or five grinders on each side, either in one or both jaws (usually one more in the upper series); and the largest number is possessed by the Hares and Rabbits, in which the upper jaw has six and the lower five grinders.* The grinders are sometimes furnished with true roots, but are more commonly open below, and provided, like the incisors, with a permanent pulp. They are sometimes tubercular, at least in youth, but generally show a flat, worn surface with transverse bands, or re-entering folds, and sometimes cylinders of enamel, which display a great variety of patterns. Sometimes the enamel is confined to the surface of the tooth; in other cases each tooth is, as it were, made up of two or more variously-shaped tubular portions of enamel, filled up with dentine. Curiously enough, this structure of the grinders, especially the arrangement of the transverse ridges and plates of enamel in these little animals, reminds us strongly of the characters of the molars of the gigantic Proboscidea, in which, moreover, the incisors also are represented by the permanently-growing tusks.

The articulation of the lower jaw with the skull is peculiar, and in special relation to the armature of teeth which we have described. Instead of articulating freely, as in man and many herbivorous mammals, by which provision is made for a sort of rotatory action of the molars, or by a regular transverse hinge-joint, as in the Carnivora, the articulating surfaces are elongated in a direction parallel to the middle line of the skull, an arrangement which, like that occurring in Carnivora, has the effect of preventing much lateral movement of the jaw; but, at the same time, the pits with which the jaw articulates are open in front, so that the jaw is allowed a certain amount of play, backwards and forwards. This motion greatly increases the gnawing power of the large incisor teeth.



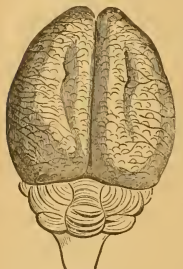
SKELETON OF THE RABBIT.

The head in the Rodents is generally of small or moderate size in proportion to the body, and the skull is usually rather elongated, and flattened on the upper surface. The tympanic bullæ are generally of considerable size; the zygomatic arch is in nearly all cases well developed; but the orbits of the eyes are never closed behind, and only in certain families is there even a small process of the zygomatic arch behind the orbits, as an indication of possible closure. Of the vertebral column we need only say that the lumbar vertebræ are remarkable for possessing large transverse processes directed forwards, and that the tail varies

* The genus *Heliophobius* among the Mole Rats is described as having six molars on each side in both jaws; but the number in this genus appears to be variable, the sixth molar being often undeveloped.

greatly in length, being sometimes longer than the body, sometimes reduced to very small proportions, whilst between these two extremes almost every grade of development may be met with.

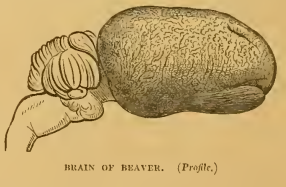
The sternum, or breast-bone, is usually long and narrow. Collar-bones are nearly always present, but in a few forms they become rudimentary, or even disappear altogether. The pelvis is long and narrow. The limbs exhibit a very great variety in their development; in many, the two pairs are nearly equal in length, but in the majority the hind limbs are distinctly longer and more powerful than their fellows, and in some groups they attain a most disproportionate length, and serve almost exclusively as the organs of locomotion. On the other hand, in the great majority of the order, the fore limbs serve in a certain degree as hands, and are used for holding the food to the mouth; and in these the radius and ulna, which are always distinct bones, retain the power of rotation. The corresponding bones in the hind limbs (tibia and fibula) are, on the contrary, firmly anchylosed together in two great groups of the order. The feet have usually five toes, but sometimes this number is reduced to four, or even to three, in the hind feet. These toes are armed with claws, which, however, in one family, acquire more or less of the appearance of hoofs.



BRAIN OF BEAVER (*from above*).

In point of intelligence the Rodentia do not stand high. The brain is comparatively small, and the cerebral hemispheres show no traces of those convolutions of the surface which are characteristic of most Mammals (*see* figures). The Capybara alone is known to have a few convolutions. The cerebellum is entirely uncovered by the hemispheres. The organs of the senses are generally well developed, and the eyes and external ears, especially, are often of large size. In the Mole Rats and some other burrowing forms, however, the external ears are entirely wanting, and the eyes are very much reduced in size, and in some instances even concealed beneath the skin. The intestinal canal is long, and in all but one family furnished with a distinct cæcum.

The body in the Rodents is generally plump and short, and the head is borne upon a short neck. The limbs also are usually short, so that the belly is close to the ground; but in some cases all four legs are of moderate length, or, as already stated, the hind legs are enormously developed, forming powerful leaping organs. In general structure, as to a certain extent in habits, there is, in fact, a most striking parallelism between the Rodentia and the Insectivora (*see* Vol. I., p. 343); in both we find arboreal and terrestrial forms, and among the latter some specially organised for burrowing in the earth, and others equally adapted for springing lightly over its surface; a few, also, in both orders, are aquatic. But here the parallel ceases. The dentition in the two groups is widely divergent, and, as might be anticipated from this circumstance, the food is very different; for, although some Rodents, such as the common Mouse and Rat, are omnivorous, there is no doubt that, as a whole, the Rodents must be regarded as vegetarians. Grass and the leaves of plants and trees furnish some of them with nourishment; whilst others feed upon fruits, seeds, and nuts, in the consumption of which last the powerful incisor teeth come into play. Many species lay up stores of food for the winter season, of which they pass more or less in a state of torpidity; and some of these are provided with cheek-pouches, often of considerable size, in which to convey their harvest into their store-houses.



BRAIN OF BEAVER. (*Profile.*)

As might be expected from the great number of species belonging to this order, and their general uniformity of structure, their classification is a matter of some difficulty, and very different views as to their relationships have prevailed at different times. Nowadays, however, zoologists have arrived at something like uniformity of opinion in this matter, and except in some minor points they may be said to be pretty nearly agreed. In the following sketch of the natural history of the Rodents we shall follow the classification proposed by the late Mr. E. R. Alston in the *Proceedings of the Zoological Society*. Mr. Alston accepted the division of the order into two primary groups (sub-orders),

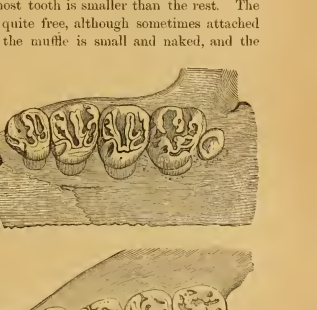
proposed fifty years ago by Professor Gervais, and characterised by the number of incisor teeth. The first of these sub-orders, which includes by far the majority of the Rodents, is formed by those species which never at any period of their lives possess more than two incisors in the upper jaw, and have the enamel on these strictly confined to the front surface of the teeth. These are denominated SIMPLICIDENTATA, or SIMPLE-TOOTHED RODENTS. In the second group, which includes only the Hares, Rabbits, and Calling Hares, we have those species which in the adult state possess four incisors in the upper jaw, namely, two large and efficient teeth, and behind these two small, almost rudimentary incisors (*see* figure of the dentition of the Hare on p. 82). These are called DOUBLE-TOOTHED RODENTS, or DUPLICIDENTATA.

SUB-ORDER I.—SIMPLE-TOOTHED RODENTS.

Besides the characters derived from the number of incisor teeth above mentioned, several other peculiarities of structure seem to show the existence of a decided difference between the Simple-toothed and Double-toothed Rodents; but most of these are of a rather abstruse nature, and need not be noticed here, the most important additional distinctive characters of the former being that the bony palate is well developed, and that the fibula does not articulate with the calcaneum, or heel-bone; whereas in the Double-toothed Rodents the palate is reduced to a mere bridge between the portions of the upper jaw in which the teeth are inserted, and the fibula does articulate with the heel-bone.

The Simplicidentata include a great number of families, and various attempts have been made to group these under larger heads; but it must be confessed that, owing to the way in which the families approach one another, it is difficult to bring them together in sections capable of being very strictly defined. Certain broad principles of relationship are, however, generally recognised, and Mr. Alston represented these by placing the Simple-toothed families under three great sections, the first indicated by Mr. Waterhouse—the Squirrel-like, Mouse-like, and Porcupine-like Rodents.

The Squirrel-like Rodents have four molars on each side in the lower jaw, and either four or five in the upper. When the latter number is present, the foremost tooth is smaller than the rest. The fibula remains as a distinct bone through life, and is usually quite free, although sometimes attached to the tibia at the extremity. The upper lip is usually cleft, the muffle is small and naked, and the nostrils are comma-shaped, with the rounded part above. The zygomatic arch is formed chiefly by the process of the malar bone, which is not supported below by a continuation of the zygomatic process of the maxillary. The collar-bones are perfect. The tail is usually cylindrical and hairy.



TEETH OF THE TAGUAN.

The Mouse-like Rodents agree with the preceding in the characters of the upper lip, muffle, and nostrils, but they have the tibia and fibula completely united for at least the last third of their length. The zygomatic arch is slender, and the malar process rarely extends so far forward as in the preceding group, and is generally supported below by a continuation of the maxillary process. The collar-bones are perfect, except in one very small family; and the tail is cylindrical, and although sometimes hairy, more commonly covered with scales arranged in rings. The number of molar teeth in this section varies from three to six * on each side in each jaw, but three is the most usual number.

The Porcupine-like Rodents, with one exception, have four molars on each side in both jaws; the fibula distinct throughout life; the upper lip rarely cleft; the muffle clad with a velvety coat of fine hairs; and the nostrils either S-shaped or straight. The zygomatic arch is stout, and the malar process does not advance far forward, nor is it supported below by the maxillary process.

* See Note on p. 83.

SECTION I.—(*SCIUROMORPHA.*) SQUIRREL-LIKE RODENTS.

FAMILY I.—SCIURIDÆ.

This first family, which includes the true Squirrels and the Marmots, is distinguished from the rest of the section by the possession of five rooted molars on each side of the upper jaw (*see* figure of

COMMON SQUIRREL.

the teeth on p. 85), the first being very small and sometimes deciduous, and four molars on each side of the lower jaw, and by the presence on the skull and zygomatic arch of small processes, indicating the posterior boundary of the orbits (*see* figure of the skull on p. 82). The molars are tubercular, at least at first; but the summits of the tubercles are generally more or less worn down as the animal increases in age.

The true Squirrels, which may be regarded as the types of this family, are distinguished by their slender and graceful forms, and their long and generally bushy tails, the latter character having originated their classical name of *Sciurus*, as a compound of two Greek words, indicating their habit of carrying their tails thrown up, so as to shade the back. Our COMMON SQUIRREL (*Sciurus vulgaris*) may serve as a good example of this division of the family. It is too well known as a pet to need any detailed description; its elegant form and graceful movements, the rich brownish-red colour of its upper surface, contrasting with the white of the belly, and the beautifully-pencilled or tufted ears, which, combined with its bright black eye, give it such a lively appearance, must be familiar to every one. When full-grown, the Squirrel measures from eight to ten inches in length of body, and has a tail seven or eight inches long. British specimens are generally smaller than those from the Continent of Europe. It varies considerably in colour with the seasons, especially in northern regions; but even in Central Europe and in Britain the fur of the sides and back becomes mixed with a certain quantity of greyish-white hairs in the winter, whilst in Lapland and Siberia the whole upper surface acquires a grey tint at that season. In the summer also the ear-tufts diminish, or altogether disappear. In the Alps and Pyrenees, there is a variety having the back of a dark brown colour, speckled with yellowish-white. This has been described as a distinct species, under the name of *Sciurus alpinus*.

The Common Squirrel is a widely-distributed species. It is abundant all over Europe, except, according to Pallas, in the Crimea, and extends beyond the Ural Mountains through the whole length of Southern Siberia to the Altai and the Amoor region. It occurs in the Caucasus, and probably in Persia. Everywhere it haunts the woods and forests, living chiefly upon the trees, among the branches of which it displays the most astonishing agility. On the ground—to which, however, it does not often descend—it is equally quick in its movements. If alarmed under these circumstances, it dashes off to the nearest tree with lightning-like rapidity, and by the aid of its sharp claws rushes up the trunk till it has reached what it considers a safe elevation, when the little sharp face and bright eyes may be seen peeping at the intruder, apparently in triumph over his supposed disappointment.

The food of the Squirrel consists chiefly of nuts, beech-mast, acorns, and the young bark, shoots, and buds of trees. In eating the former articles, they are held in the fore-paws, which thus supply the place of hands, and the strong incisors soon make a way through the outer shells into the contained kernels, which alone are eaten; for in all cases in which the kernel is coated with a coarse brown skin (as in the common hazel-nuts), the Squirrel carefully removes every particle of this from the portions on which he feeds. The bark, buds, and young shoots of trees seem generally to be attacked by the Squirrel when he finds a deficiency of other and more congenial nourishment; but this is so regularly the case in the spring of the year, that these animals actually cause a great amount of damage to the trees in forest regions. Hence, not unnaturally, the Squirrel is regarded in forest countries as a most mischievous little animal, whose depredations are not to be condoned on account of its elegant appearance and lively habits. As another unamiable quality, may be mentioned its habit of plundering birds' nests and eating the eggs, which appears to be established upon unquestionable evidence. In some northern regions the inhabitants turn their Squirrels to a more profitable use than putting them, as we so often do, into a sort of treadmill. In Lapland and some parts of Siberia, especially on the banks of the Lena, these animals are killed in great numbers for the sake of their grey winter-coats, which, however, are not equal in beauty to those of the North American Grey Squirrel.

The Squirrel passes the greater part of the winter in a torpid state, lying coiled up in some hole of a tree, where its long bushy tail is of service in keeping it warm and comfortable. On fine and warm days, however, it rouses itself from its slumbers; and, as if foreseeing the occurrence of such days, it lays up in the autumn stores of nuts, acorns, and beech-mast, upon which it can feed when it wakes during the winter. This winter provision is not laid up all in one place, but stored away in several different holes in trees surrounding the place of its own retreat.

Squirrels appear to be strictly monogamous, pairing for life, and constantly inhabiting the same dwelling. The young, three or four in number, are produced in June, and for their reception the parents prepare a very beautifully constructed nest, formed of interlaced moss, leaves, and vegetable fibres, which is placed either in the hole of a tree, or in the fork between two branches. The young

Squirrels are very carefully attended by both parents, and the family remains united until the following spring, when the young go out to find partners, and settle themselves in the world.

The Common Squirrel may serve as an example of the whole genus *Sciurus*, which includes the ordinary Tree Squirrels, the species of which are very numerous, probably more than one hundred, and distributed over nearly all parts of the world. The species are most numerous in the warm Oriental regions, in India, and the countries and islands lying to the east of it, from which nearly fifty species have been recorded. The northern parts of the Old World only possess half a dozen species, but North America has about eighteen, many of which are considerably larger than the European Squirrel. The most striking of the North American species are the GREY SQUIRREL (*Sciurus carolinensis*) and the FOX SQUIRREL (*Sciurus niger*), both of which are abundant in the Atlantic States, and vary considerably in colour, presenting both grey and black individuals.

BLACK FOX SQUIRREL.

Besides the ordinary Squirrels, a considerable number of other species are arboreal in their habits, and, indeed, even more strictly so than the true Squirrels. These are the Flying Squirrels, as they are called, which may be at once distinguished from the others by the presence of a large fold of skin, extending along the sides of the body, and including the limbs as far as the wrists and heels (*see* figure on next page). In the case of the Common Squirrels, it is observed that in performing leaps of any considerable extent the limbs are stretched out, and the long, bushy tail extended, so as to give the animal as large a surface as possible; but in the Flying Squirrels, as in the Flying Lemur (Vol. I., p. 344), when the limbs are extended laterally the folds of skin (*patagia*) become tightly stretched, and form a regular parachute, which seems to give the animal essential support in its most extensive leaps. The extent of this membrane is increased by means of a sort of bony spur, which articulates with the wrist.

The TAGUAN (*Pteromys petauristu*) is a large species, indeed, the largest of the whole family Sciuridæ. It measures about two feet long, and has a bushy tail of nearly equal length. Its ears are pointed, but not tufted, and its eyes are large and prominent. Its colour above is greyish-black, produced by a mixture of entirely black hairs with others having the tips greyish-white; beneath it is greyish-white. About the head and on the limbs the fur is tinged with brown or chestnut brown, and the lateral folds are sometimes of the latter colour, sometimes blackish-brown above and grey beneath. The tail is rounded in its form

This species inhabits the peninsula of India and Ceylon, Malacca and Siam, where it is found only in the forests, living in trees, either singly or in pairs. Its activity is chiefly nocturnal, in which respect it differs from the ordinary Squirrels. During the day it sleeps in the holes of trees, but at night it comes forth, climbing and leaping with the greatest rapidity about the trees on which it lives. While thus engaged the lateral membranes are loosely folded at the sides of the body; but from time to time the Squirrel wishes to pass from one tree to another at some distance, and then it ascends to a considerable elevation and springs off, at the same time extending all four limbs as much as possible, when the tightly-stretched folds of skin lend the body a support, which enables it to glide through the air to some distance, although it seems always to alight at a lower level than that from

TAGUAN.

which it started. During these aerial excursions the long bushy tail serves as a sort of rudder, and enables the animal even to change its course during flight. Of the habits of the Taguan very little is known. It appears to feed upon fruits, and is exceedingly shy and fearful. Of a nearly-allied species which he observed in China, Mr. Swinhoe says that the nest, which was placed high up in a large tree, measured about three feet in diameter, and was composed of interlaced twigs, and lined with dry grass. It contained only a single young Squirrel; but this might be exceptional.

Some nine or ten additional species of the genus *Pteromys*, which includes the Flying Squirrels with cylindrical tails, are found in the forest regions of India and of the countries to the east of that peninsula, including China, Formosa, and Japan. The same region also harbours three or four species of another kind of Flying Squirrel, in which the long hairs of the tail are arranged in two rows, and the tail is flat instead of cylindrical. These animals, to which the name of *Sciuropterus* has been given, are, however, more numerous in the north, where their distribution extends from Lapland and Finland, through Siberia, to Northern China and Japan. Squirrels of this genus also occur over the whole continent of North America and as far south as Guatemala. The best known of the Old World species is the POLATOUCHE (*Sciuropterus volans*), which inhabits the north-eastern parts of

Europe and nearly the whole of Siberia. It is an elegant little creature, about six inches in length, and with a broad, flat tail, rather shorter than the body: as, indeed, is the case in all the *Sciuropteri*. Its silky coat is in summer of a tawny brown on the upper surface, darker on the flying membrane and the outsides of the limbs, beneath pure white; whilst the tail is greyish above and light rusty red beneath. In winter the fur becomes longer and thicker, and appears of a silver grey colour on the upper surface. The Polatouche lives in the birch woods, or in places where pines, firs, and birches grow intermingled; but the presence of the birch seems to be a necessity of its existence. It is met with singly or in pairs, but always on the trees, sleeping during the day in its nest or in the hole of a tree, and coming forth at dusk to climb and leap about the branches with great agility. In going from tree to tree by the aid of its lateral membranes, it is said to cover distances of twenty or thirty yards with ease, always, however, taking its leap from the highest branches of the tree it starts from, and alighting at a considerably lower level. Its food consists of nuts, seeds, berries, the buds, young shoots, and

POLATOUCHE.

catkins of the birch, and the young shoots of pines and firs. The nest is made in the hole of a tree, carefully lined with soft moss and herbage. Like the Common Squirrel, the Polatouche sleeps through the cold weather, but wakes up from time to time and goes out in search of food.

This group of Flying Squirrels is also represented on the North American continent. The number of species seems rather uncertain, some authors making it two, others four; while Mr. J. A. Allen regards all the North American Flying Squirrels as belonging to a single species, which varies greatly in size in different localities. This species is the Assapan (*Sciuropterus volucella*), one of the smallest of its family, the length of its head and body being only from four and three-quarters to seven and a half inches; the smaller specimens (var. *volucella*) being found in the more southern States, and even as far south as Guatemala; and the larger ones (var. *hudsonius*) in more northern localities. In its habits this elegant little Squirrel resembles the Polatouche, but appears to be more sociable. It thrives well in confinement.

Besides these Tree Squirrels, a few species of the Sciurine sub-family live upon the ground. In Abyssinia and in other parts of Africa some curious animals, forming the genus *Xerus*, are found, distinguished by their very small ears, longish limbs, and the singular texture of their hair, which scantily clothes the skin and generally takes the form of flattened spines. They have a slender body, a pointed head, and a longish tail. These animals live in elevated forest regions, and even upon comparatively barren steppes, where they burrow in the ground under rocks, or among the roots of

trees and bushes. They are diurnal, and feed chiefly upon buds and herbage, but also devour small birds, eggs, and insects. The best known species (*Xerus rutilans*) is about twenty inches long, of which the tail makes about nine inches. Its colour is reddish-yellow above, becoming paler on the sides, and whitish below.

The true Ground Squirrels (*Tamias*) are distinguished from the rest of the Squirrels (*Sciurinæ*), and approach the Marmots, which form a second sub-family of Sciuridæ. Like some of the latter, they possess large cheek-pouches opening into the mouth. The ears in this genus are short; the fourth toe of the fore feet is longer than the rest, as in all the Sciurinæ; the limbs are short, and nearly equal in length; and the tail is shorter than in the true Squirrels. In general form and appearance, however, the Ground Squirrels greatly resemble the latter, except that they are rather stouter in the body. Four species of this group inhabit the continent of North America, where they are known as Chipmunks; and one of these, according to Mr. J. A. Allen, is identical with

COMMON CHIPMUNK.

the only known Old World species (*Tamias asiaticus*), which is found in North-eastern Europe and across Northern Asia, as far as the mouth of the Amoor, North China, and Japan. This species, which goes by different names in the different localities which it inhabits, and the Common Chipmunk (*Tamias striatus*) of the United States, agree very closely in all respects, and are exceedingly pretty little animals, with light-coloured fur adorned with darker stripes, varied in the case of the Chipmunk with streaks of white. They are from eight to ten inches long, including the tail. These animals live in burrows in the ground, and feed upon nuts, acorns, grain, and other seeds of various kinds, of which they lay up great stores in the autumn, carrying home their provisions in their cheek-pouches, which they stuff as full as they can hold. In this way they do no small damage to cultivated grounds near their haunts, plundering the corn and maize fields very freely; over eight pounds of corn in the ear are often found in the granaries of the Siberian form. The burrow is made deep enough to protect the animals from frost in winter, and the sleeping chamber contains a large nest of leaves and grass, in which several individuals, probably the parents with their grown-up family, sleep through the cold weather; but it must be remarked that their torpidity is very imperfect, and that they have frequent recourse to the supplies of food which they have stored up during the summer and autumn in separate chambers at the ends of lateral passages. These stores are so large that they generally greatly exceed the wants of the provident little animals.

and in the spring the residue is greedily devoured by Wild Pigs and Bears. Even the poorer human inhabitants of the countries frequented by the Ground Squirrels do not disdain to eke out their scanty means of subsistence by plundering the hoards of these animals. Many of them perish in severe winters, great numbers are destroyed by man, by the smaller Carnivora, and by birds of prey, but, nevertheless, they manage to hold their own, in consequence of the great fertility of the females, which produce several young twice in the year, namely, in May and August. At pairing time the males fight violently.

MOLAR TEETH OF THE MARMOT.

From the Ground Squirrels we pass, by a perfectly natural transition, to the MARMOTS (*Arctomyinæ*), the second sub-family of Sciuridæ. These animals differ from the preceding forms by their broader incisors, shorter tail, and stouter form of body, and by having the third finger longer than the rest. The first upper molar, also, is larger and more persistent than in the Squirrels, and the other molars differ in structure (*see* figure). The Marmots are all terrestrial animals, living and storing provisions in burrows, which they dig in the ground, and they are strictly confined to the northern parts of the two hemispheres.

The nearest approach to the Squirrels is made by the SPERMOPHILES (*Spermophilus*), several species of which occur in North America from Mexico to the Arctic regions, but never to the east of the great central prairie region; whilst in the Old World their domain extends from Silesia, through Russia, and across Asia, to the Amoor and Kamstchatka. The Spermophiles are Squirrel-like in form and have rather short tails, but in the American species this organ is generally longer than in those of the Eastern continent. On the thumb the claw is either very small or altogether wanting; the two series of molars are nearly parallel, and the mouth is furnished with large cheek-pouches. The ears are very small. These animals live in society, and prefer a dry, sandy, or loamy soil, in which they can easily make their burrows, which terminate in a chamber lined with grass and herbage, and have, besides, side-chambers, in which provisions can be stored for winter use. Like the other species of the family, the Spermophiles pass the winter in a state of partial torpidity. In the summer they are exceedingly lively and playful. Their food consists of roots, berries, and seeds of various kinds, and their winter stores of these articles are carried into the burrows in

STRIPED SPERMOPHILE, OR GOPHER.

their large cheek-pouches. The females are very prolific, producing from four to eight young at a birth, and in some cases even as many as ten have been found. The commonest and most widely distributed of the North American species is the STRIPED SPERMOPHILE, or GOPHER (*Spermophilus tredecimlineatus*), a pretty little creature of from six to eight inches long, usually of a

BURROWS OF THE PRAIRIE DOG.

chestnut brown colour with seven yellowish-white lines running along the back and between these six rows of small squarish spots of the same colour. This species extends its range from the Red River in Canada southwards as far as Texas, and is common on the prairies east of the Mississippi. This and some other species of the genus are said to be very carnivorous in their habits, preying upon small birds and mammals; and the Gopher was even described as feeding upon the flesh of Bisons, which it found lying dead on the prairies. The other American species are more local in their distribution; four of them occur in Mexico, and one of these is only known from that country. Of the Old World species the best known is the SISEL, or SUSLIK (*Spermophilus citillus*), which is abundant in Central and

Eastern Europe and in Siberia. Several other species are known from Asia Minor, Siberia, and Central Asia.

The BARKING SQUIRRELS, or PRAIRIE DOGS, of which two species (*Cynomys ludovicianus*, *see* figure on p. 81, and *C. columbianus*) are found in the United States of America, are of a stouter form than the Spermophiles, and have the ears and tail short. The claws are well developed on all the toes of the fore feet, the cheek-pouches are shallow, and the two rows of grinding teeth converge towards the back of the mouth. These animals are peculiar to North America, where the former inhabits the prairies east of the Rocky Mountains, and the latter is found on the plains of the Columbia river, and in other parts of the western territories as far south as New Mexico. The best known of the two species is the *Cynomys ludovicianus*, to which the name of the PRAIRIE DOG was first applied: this name being given to it from a fancied resemblance of its voice to the barking of a small Dog. It measures about a foot in length, and its tail is about four inches long. Its colour on the upper surface is reddish-brown, variegated with grey, and with a few scattered black hairs; the tail is flattened, and brownish-black towards the end, and the lower surface is brownish or yellowish-white. These animals live together in great societies, especially upon those portions of the prairies where the so-called buffalo-grass (*Sesleria dactyloides*) grows most luxuriantly, this grass and succulent roots constituting their chief food. They live in burrows, which they dig in the ground at a distance of twelve or fifteen feet apart; a hard-beaten path runs from burrow to burrow, and would seem to give evidence of the sociable disposition of the animals; and at the mouth of every burrow there is a little hillock, formed by the earth thrown out of it, which serves the occupant as a watch-tower. These burrows are usually so numerous upon favourable pieces of ground that the space occupied by them is quite populous, and presents a scene of considerable animation when the inhabitants are out in the pursuit of their business or their pleasure, and hence they are in common parlance spoken of as "towns" or "villages." Their curious appearance is heightened by the almost constant presence in them of numerous small Owls, of the species known as the Burrowing Owl (*Athene cunicularia*), a widely-spread species, which in some places digs its own subterranean habitation, but on these prairies saves itself the trouble by taking possession of the deserted abodes of the Prairie Dogs. These birds are diurnal in their habits, and are to be seen mixed up with the Prairie Dogs in their settlements. Another inhabitant of the burrows is the Rattlesnake; and some of the earlier observers thought that the Prairie Dogs, Owls, Rattlesnakes, and some other animals, such as Horned Frogs and an occasional Tortoise, occupied the same burrow, and lived there on the most amicable footing. Unfortunately, this paradisaic picture is an imaginary one. It is true that the Rattlesnake does take up his abode in the Prairie Dog's burrows, but he either selects a deserted one, or dispossesses, and perhaps devours, the rightful owner; and his object in his residence among the lively little Marmots is anything rather than peaceful, as they constitute his favourite food. The little Burrowing Owl has also been said by some writers to feed on the young Prairie Dogs; but this is not proved, and the food of the Owls is known to consist chiefly of Grasshoppers and Crayfish. According to the latitude in which they live, the Prairie Dogs seem to be more or less subject to torpidity during the winter.

The true MARMOTS (*Arctomys*) are nearly related to the Prairie Dogs. They are stout in the body, have a short tail, and a rudimentary thumb with a flat nail; and are either entirely destitute of cheek-pouches or have mere indications of those organs. The rows of molar teeth are placed nearly parallel to each other in each jaw. The skull is broad and flat above, with a depression between the orbits; and the post-orbital processes are larger than in any other Sciuridæ. The Marmots are confined to the Northern hemisphere, but over it they are widely distributed in both continents. Of the Old World species, the best known are the BOBAC (*Arctomys Bobac*) and the ALPINE MARMOT (*A. Marmota*), of which the former extends from the south of Poland and Galicia over the whole of Southern Russia and Siberia to the Amoor region and Kamstchatka, whilst it is found in elevated situations as far southward as Cashmere, Tibet, and the Himalayas; and the latter inhabits only the higher regions of the Alps, Pyrenees, and Carpathians. In North America the common species is the WOODCHUCK (*Arctomys Monax*), the distribution of which is from the Carolinas northward to Hudson's Bay, and westward from the Atlantic coast to Missouri, Iowa, and Minnesota; the Rocky Mountain region is inhabited by a distinct species (*A. flaviventer*); and a third very large species, the HOARY MARMOT, or WHISTLER

ALPINE MARMOT.

(*A. pruinosus*), which measures from twenty-three to twenty-five inches in length of body, appears to be most abundant in the north-western parts of the continent, and is said to range northward as far as the Arctic Circle. The Marmots live usually in large societies in extensive burrows, which they form underground; and in some localities, as on the great plains of Russia and Siberia, their dwelling-places are described as producing a remarkable effect, owing to the multitude of little hillocks formed by the earth thrown out of their burrows. During the summer they are in a state of constant activity, playing and running about in search of food in the neighbourhood of their dwellings. The winter they pass in a state of torpidity, in a comfortable chamber lined with soft herbage, and protected from the outside cold by the closure of the main passage leading into their abode. For a time after their retirement for the winter they continue active in their domicile, and feed upon the stores of food which they have laid up during the summer; and as a preparation for their winter sleep, they become exceedingly fat during the autumn. The Marmots are the largest members of their family, and, indeed, some of them may be reckoned among the larger Rodents. The Alpine Marmot measures more than twenty inches in length, and the Bobac about fifteen inches, exclusive of the tail.

FAMILY II.—ANOMALURIDÆ.

Some curious African animals, closely resembling the Flying Squirrels, and at first regarded as belonging to that group, were formed by Mr. Waterhouse into a distinct genus, which he called *Anomalurus*, in allusion to the peculiar characters presented by their tail. This organ, which is long and well clothed with hair, although not so bushy as in the true Squirrels, has on the lower surface of its basal portion a double series of horny scales, which project from the skin, and probably serve to assist the animal in climbing upon the branches of trees.

Besides this peculiarity, these animals exhibit certain other characters which have induced modern

zoologists to separate them from the Squirrels as a distinct family. Thus, the post-orbital processes are wanting, or nearly so; the infra-orbital openings are large; the molar teeth are four in number on each side, above and below, nearly equal in size, and not tubercular, but with a flat surface, crossed by transverse loops of enamel; and the palate is contracted in front and deeply notched behind. In the skeleton we find sixteen pairs of ribs, whereas in the Squirrels there are only twelve or thirteen pairs; and the internal anatomy, first described by Mr. Alston, is very peculiar. The flying membrane is quite as largely developed as in the Flying Squirrels, and is in the same manner extended from the wrists to the heels, and further supported by cartilaginous spurs starting from the fore limbs; but, whilst in the Flying Squirrels this spur springs from the wrist itself, in the Anomalures it projects from the elbow, and thus produces a still greater extension of the membrane. The ears are well developed, the eyes large, and the general aspect both of head and body completely squirrel-like. Six species of this family have been described, all from the West Coast of Africa. One of them occurs in the island of Fernando Po. The species figured (*Anomalurus fulgens*) is from the Gaboon. It is a handsome little creature, of a bright reddish colour, paler below, and having a small white spot between the ears. Its length is fourteen inches, and its tail is seven inches long. In some of the other species the tail is as long as the body. Of the habits of these animals little is positively known, but they are said to feed upon fruits. They probably resemble the Flying Squirrels in their general mode of life.

FULGENT ANOMALURE (From the *Proceedings of the Zoological Society*).

MOLAR TEETH OF THE ANOMALURE.

FAMILY III.—HAPLODONTIDÆ.

This is another small family, smaller even than the preceding one, for it includes only a single known species, limited in its range to the western coast of North America. This is the Sewellel, a little Rodent, first observed by the American travellers, Lewis and Clarke, in 1805 or 1806, described in 1814 by Rafinesque under the name of *Anisonyx rufa*, and afterwards, in 1829, by Sir John Richardson, as the type of a new genus, as *Aplodontia leporina*. This generic name has been corrected, in accordance with its derivation, by more recent writers, to *Haplodon*, from which the name of the family has been formed.

In this animal there are five molars in the upper and four in the lower jaw; the first upper molar

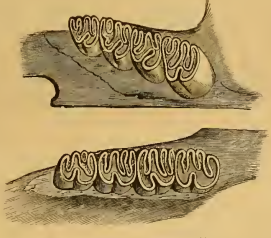
is very small, and all these teeth are rootless, simple, and prismatic, the surface of each tooth being surrounded by a mere border of enamel. The skull is very flat, very wide behind, and furnished with large zygomatic arches; between the orbits and in front it is much contracted, and there are no post-orbital processes. In the lower jaw the angular portion is twisted so as to form a horizontal ridge. The body is stout and clumsy, the tail very short, and the claws of the fore feet (which are five-toed, as well as the hind ones) are very powerful; in fact, as Dr. Coues says, "The whole organisation, viewed externally, indicates terrestrial and highly fossorial habits."

The Sewellel (*Haplodon rufus*) is about a foot long, with a tail of an inch or an inch and a half; its colour is brownish, with an intermixture of black hairs, lighter and more greyish below. The whiskers, claws, and upper surface of the feet are whitish, and the incisor teeth yellow. It inhabits the Washington and Oregon territories, from the Rocky Mountains to the shores of the Pacific, and extends also into the southern portions of British Columbia and the upper parts of California.

The Sewellel is described as having very much the same habits as the Prairie Dog, living in society, burrowing very readily in the ground, and feeding on roots and berries. Their companies, however, seem to be much smaller than those of the Prairie Dog, and they are said chiefly to frequent spring-heads in rich, moist places. They are described as having the curious habit of neatly cutting off some herb or plant, which, when packed in bundles, they lay out and expose to the sun to dry; this is probably for the purpose of storing for winter consumption. It seems to be uncertain whether the Sewellel is torpid during the winter, but probably in this respect it varies according to local conditions or the coldness of the seasons. Dr. Suckley believes that the Sewellel has several litters of young during the season. The Indians trap them, and esteem them very highly as food. Cloaks or blankets are made of their skins, which are sewn together with fibres derived from the sinews of the Elk and Deer. A robe described by Sir John Richardson was composed of twenty-seven skins.

FAMILY IV.—CASTORIDÆ.

Unlike as the Beaver may be to a Squirrel, it yet presents many characters which prove that its nearest affinity is to the animals which compose the group Sciuromorpha. This relationship has indeed been overlooked by many zoologists, but Mr. Alston and Mr. Allen have clearly shown that Professor Gervais was right in placing the Castoridæ in close juxtaposition with the Squirrels. The peculiarities which make the apparent discrepancy so striking are indeed chiefly those by which the Beaver is adapted to an aquatic life.



MOLAR TEETH OF THE BEAVER.

The Beaver, which is the sole living representative of this family, is a more powerful animal than any of the preceding, and his incisor teeth and the means of working them are especially well developed. The head is large and the skull massive, and furnished with a distinct median (sagittal) crest for the insertion of the strong muscles which move the lower jaw. There are no post-orbital processes. There are four molars on each side in each jaw, and these are nearly similar in size and structure; but, contrary to what we have seen in the preceding groups, the first molar is the largest, and the others diminish in size towards the hinder end of the row. The series of teeth in the two sides of the mouth converge toward the front; and the teeth themselves, which are for a long time rootless, and only close up to form a simple root when the animal grows old, show three folds or loops of enamel on one side, and a single fold on the other: the three folds entering from the outer surface of the tooth in the upper jaw, and from its inner surface in the lower.

The general form is stout and heavy, especially in the hinder parts; the tail is of moderate length, broad, flattened, and covered with a scaly skin; the feet are all five-toed, the fore pair considerably smaller than the hinder, but all well furnished with claws, and the hinder pair fully webbed to the extremities of the toes. The wrist has a large ossicle, in addition to those usually

composing that part of the body. The eyes are small, have the pupil vertical, and are furnished with a nictitating membrane; the ears are small and short, and their antitragus can be so applied to the head as almost entirely to close the auditory aperture; and the nostrils are also so arranged as to be capable of closing.

The Beaver is usually about two feet and a half long, and is, therefore, one of the largest of the Rodentia, except the Capybara. The tail, which is flattened above and below, and of an elongated oval form, measures about ten inches. The muffle is naked; the ears scaly; the soles of all the feet are

BEAVER.

naked, and their upper surfaces clothed with hairs; and the second toe of the hind feet is usually furnished with a double claw, the additional one being placed beneath the other. The general colour of the fur is reddish-brown on the upper surface, lighter and greyish below. The colour varies a little in different individuals, and appears to become darker, or even blackish, in northern localities. White or pied individuals are not uncommon. The Beaver appears to increase in size for some years after it has attained maturity. Mr. Allen says that in America "two-year-old Beavers generally weigh about thirty-five to forty pounds, while very old ones occasionally attain a weight of upwards of sixty." The size of the skull seems to increase throughout life; the thickness and density of the bones also increase, and the ridges for the attachment of the muscles become stronger in old individuals.

The Beaver is, or has been, distributed generally over all the northern parts of the Northern hemisphere, especially in the forest regions. Formerly it ranged over the whole of Europe, including

the British islands, where there is historical evidence of its former existence, besides the skulls and bones which have been found in various places, but especially in the Fen lands. At present the animal appears to be completely exterminated in the southern parts of Europe from France southwards, with the exception of a small colony on the Rhone, which we believe is still in existence; and only a very few individuals survive in Germany, where they are found on a tributary of the Elbe, and in one or two other places. In some parts of Poland, Russia, and Austria, and in the Scandinavian peninsula, they still, to a greater or less extent, hold their ground; and in Asia they abound about the rivers of Siberia, and in the streams which flow into the Caspian Sea. In North America Beavers formerly abounded from Texas, and, according to manuscript evidence cited by Mr. Allen, even from Mexico, northward to the extreme limit of forest growth, and from the Atlantic to the Pacific coast. The constant pursuit to which the animals were subjected, in consequence of the demand for their skins, greatly diminished their numbers, and in many localities altogether exterminated them; but they still occur over a very large extent of the North American continent, especially in the western territories, where they are even abundant in some of the wilder parts.

In the preceding statements we have spoken of the Beaver as forming a single species; but it has long been a moot question with zoologists whether the Beavers of the Old and New Worlds were or were not specifically identical. The external differences are very slight, and those observed in the skull, upon which most stress has been laid, do not appear to be of sufficient importance for the separation of the animals as distinct species. They consist chiefly in the greater breadth of the anterior portion of the skull, including the inter-orbital space; the extension farther back of the nasal bones, the greater size and depth of the basilar cavity and the more anterior position of the auditory bullæ, in the European Beaver; but the examination of large series of specimens has proved that the skulls from both hemispheres present many exceptions, in which one or more of the peculiarities which they ought to exhibit do not occur: a circumstance which of necessity greatly invalidates the distinction founded upon such characters. Dr. Ely sums up the results of an extended investigation in the following words:—"The extremes of difference, in their aggregate, on the one side and on the other, are sufficiently striking to justify us in regarding them as varieties of one and the same species; while the want of constancy in these peculiarities suggests the inference that these variations are due to long separation of the races, and to accidental causes, rather than to original diversity of the stock." The Beaver may thus be regarded as a species with two geographical forms (varieties or subspecies), viz., *Castor fiber*, var. *europæus*, and *Castor fiber*, var. *canadensis*.

So much has been written upon the habits of the Beaver, that the following short statement will suffice to give the leading facts in the natural history of the animal, the accounts of the marvellous sagacity of which, given by the older writers, have, perhaps, invested it with an exaggerated interest.

In populous countries the Beaver is contented, like the Otter, with a long burrow for his residence; but in the wilder regions of Siberia and North America his dwelling-place is a much more complicated affair. But even in these regions, according to some authorities, a certain number of Beavers—always males—show a lazy unwillingness to take part in the common labours of the colony; and these, as idlers, are expelled from the community, often with rather severe treatment, and then take up their abode by themselves in holes, which they dig out in the banks of rivers, whence they are called "terriers." On the other hand, it would appear that the building instinct which is so remarkably manifested by the Beaver is not always extinct even in those which inhabit populous countries, for we have a most interesting account from M. Meyerinck of the construction of a lodge, and even of a dam, by the colony of Beavers on a tributary of the Elbe.

In North America, from which we have the fullest accounts of the habits of the Beavers, these animals select for their habitation some small stream running through a locality well covered with trees, especially willows, birches, and poplars, upon the bark of which they chiefly feed. These trees they cut down with their powerful incisor teeth, usually selecting those from the thickness of a man's arm to that of his thigh, but sometimes even felling trunks eighteen inches in diameter. The operation, which at first sight would seem to be a rather difficult one for an animal like the Beaver to perform, is effected by gnawing all round the trunk for a certain distance, and gradually working deeper and deeper into its substance in the middle of the part attacked, until at length the tree stands

upon quite a slender piece of wood, with the trunk both above and below this tapered off into the form of two cones, united by their apices. The work is done as sharply and neatly as if the wood had been cut away by a chisel; and the animals are said to have the sagacity to weaken the trunk more on the side that looks towards the water than on the opposite side, by which means, when it falls, it will generally do so in the direction of the water, which materially facilitates the further operations of the Beavers. The quantity of trees cut down by them in this way is very great, so that in the neighbourhood of a Beaver encampment the ground is everywhere full of the stumps which they have left.

These tree trunks are then cut up into lengths of five or six feet, which, after their bark has been stripped off and eaten, are employed in the formation of a lodge, to serve as a shelter for the company of Beavers forming it. Access to the lodge is obtained by means of several subterranean passages, which always open under water, and lead up into the chamber occupying the interior of the lodge. The lodge is usually of an oven-like shape, and is built close to the edge of the water; its walls are very thick, and composed of the above-mentioned trunks of trees, plastered over with mud, clay, &c., mixed with grasses and moss, until the whole fabric measures from twelve to twenty feet in diameter, and forms a hill some six or eight feet high. The larger lodges are in the interior about seven feet in diameter, and between two and three feet high; and the floor of this spacious chamber is covered with fine chips of wood, grasses, and the soft bark of trees, which serve to form the beds of the occupants. Occasionally the lodges are said to contain store-rooms. In front of the lodge, according to Audubon, the Beavers scratch away the mud of the bottom until they make the water deep enough to enable them to float their pieces of timber to this point, even when the water is frozen; and, communicating with this, a ditch surrounds the lodge, which is also made so deep that it will not readily freeze to the bottom. Into this ditch, and the deep water in front of the lodge, the passages by which access to the water is obtained always open, and thus the inhabitants can at any time make their way out when their business requires them to do so. In the neighbourhood of the lodge the timber cut into lengths, as above described, is piled up, so as to furnish a supply of food as it is required; and the pieces of timber, after being stripped of their bark, are usually employed by the Beavers either in repairing their lodges or in constructing or strengthening the dams which they very frequently throw across the streams haunted by them. These dams, which are destined to keep the water of variable streams up to the necessary height for the convenience of the Beaver, are wonderful pieces of work, and almost justify the marvellous stories told of its intelligence and sagacity by the older writers. They are often of great length—sometimes 150 or 200 yards and more—and run across the course of the brook inhabited by the Beavers—sometimes in a straight line, sometimes in a curved form, according to peculiarities in the ground or the stream, and the exigencies of the engineers. They are composed, like the lodges, of lengths cut from the trunks and branches of trees, filled in with smaller sticks, roots, grasses, and moss, and all plastered with mud and clay in a most workmanlike manner, until the whole structure becomes quite water-tight. Their height is from six to ten feet, and their thickness at the bottom sometimes as much as double this, but diminishing upwards by the slope of the sides until the top is only from three to five feet wide. These dams convert even small rivulets into large pools of water, often many acres in extent; and in districts where Beavers abound these pools may occupy nearly the whole course of a stream, one above the other, almost to its source. Their use to the Beavers, as constantly furnishing them with a sufficiency of water in which to carry on their business, and especially to float to their lodges the tree trunks necessary for their subsistence, is easily understood; but it is a more remarkable circumstance that by this means the Beavers exercise a considerable influence upon the external appearance of the locality inhabited by them, which may persist even long after they have themselves disappeared. In and about the pools the constant attacks of the Beavers upon the trees produce clearings in the forest, often many acres in extent; at the margins of the pools the formation of peat commences, and under favourable circumstances proceeds until the greater part of the cleared space becomes converted into a peat-moss. These peaty clearings are known as Beaver-meadows, and they have been detected in various countries where the Beaver is now extinct.

As in the case of the majority of Rodents, the chief activity of the Beaver is nocturnal; and it is only when driven from its lodge by a high flood, or in the wildest and most sequestered localities, that

it goes about during the day. It swims quickly, but entirely by the agency of the hind feet, the fore feet being used chiefly for carrying and building operations, and for conveying the food to the mouth. Before diving, it is said to slap the surface of the water with its tail, producing a sound that may be heard at a considerable distance. On land it sometimes travels a good way in the warm season, and is then stated to indulge in a change of diet, feeding upon roots and fruits, and sometimes upon corn. The roots of the water-lily (*Nuphar*) are also said to constitute part of its food. The Beaver is hunted —but less now than in former years—for the sake of its skin, the soft under fur of which was much used in the manufacture of hats. It is asserted that the flesh is very good, but according to some authorities, only certain parts of it are palatable; and Audubon declares that the tail, which is regarded as a peculiarly choice morsel, closely resembles marrow, and is so rich that only those whose stomachs are incapable of being upset by greasy food can eat more than a very little of it.

The Beaver has been hunted not only for its fur, but also, and from time immemorial, for the sake of a peculiar secretion produced by it, which, under the name of *Castoreum*, has been for many centuries a highly-esteemed medicament. This substance is secreted in a pair of glandular pouches, situated in the inguinal region of the male Beaver; and it would seem that it was almost entirely in order to procure these that the ancients hunted this animal. Even in connection with this they had wonderful tales to tell of its sagacity: as how that, when it was pursued and found itself unable to escape, it would throw itself upon its back, as if to invite the hunter to take what he wanted and spare its life. Nay, some ancient writers seem to have believed that the Beaver would go the length of biting off its own castoreum glands, and leaving them for the hunter to pick up! Castoreum contains some volatile oil and resin, and a peculiar crystallisable substance called castorine; it is used in medicine as a stimulant, and seems to act especially on the nervous system, but is not much employed nowadays. Its odour, which appears to spread over a considerable space, is described as being very attractive to other Beavers. Audubon states that it is used for this reason as a lure by the American trappers.

CHAPTER II.

THE DORMOUSE, LOPHIOMYS, RAT, AND MOUSE FAMILIES.

THE MOUSE-LIKE RODENTS—MYOXIDÆ—Characteristics—THE DORMOUSE—Description—Habits—Activity—Food—Winter Condition—THE LOIR—THE GARDEN DORMOUSE—LOPHIOMYIDÆ—How the Family came to be Founded—THE LOPHIOMYS—Milne-Edwards' Opinion—Skull—General Form—Habits—MURIDÆ—Number of Species—Characteristics—Variety of Forms—Distribution—The Murine Sub-Family—THE BROWN RAT—History—Fecundity and Ferocity—Diet—At the Horse Slaughter-houses of Montfaucon—Shipwrecked on Islands—Story of their Killing a Man in a Coal-pit—In the Sewers of Paris and London—THE BLACK RAT—THE EGYPTIAN RAT—THE COMMON MOUSE—Habits—Destructiveness—Colours—THE LONG-TAILED FIELD MOUSE—Description—Food—THE HARVEST MOUSE—Description—Habits—In Winter—Agility—Their Nest—THE BANDICOOT RAT—THE TREE RAT—THE STRIPED MOUSE—Allied Genera—THE WHITE-FOOTED HAPALOTE—The American Murines—THE WHITE-FOOTED, OR DEER MOUSE—THE GOLDEN, OR RED MOUSE—THE RICE-FIELD MOUSE—THE AMERICAN HARVEST MOUSE—THE FLORIDA RAT—Description—Their Nest—Food—Mother and Young—THE BUSHY-TAILED WOOD RAT—THE COTTON RAT—THE RABBIT-LIKE REITHRODON—THE HAMSTERS—Characteristics—Appearance—Distribution—Burrows—Disposition—Food—Habits—THE TREE MICE—THE BLACK-STREAKED TREE MICE—THE GERBILLES—Characteristics—Habits—Other Genera—THE WATER MICE—Characteristics—Species—THE SMINTHUS—THE VOLES—Characteristics—THE WATER VOLE—Appearance—Distribution—Food—THE FIELD VOLE—THE BANK VOLE—THE SOUTHERN FIELD VOLE—THE SNOW MOUSE—THE ROOT VOLE—THE MEADOW MOUSE—THE PINE MOUSE—THE MUSQUASH, MUSK RAT, OR ONDATRA—Distinguishing Features—Habits—His House—THE LEMMING—Description—Food—Habits—Disposition—Their Extraordinary Migrations—THE ZOKOR.

SECTION II.—MOUSE-LIKE RODENTS (*MYOMORPHA*).

THE Myomorphic, or Mouse-like group of Rodents, includes a much greater variety of forms than the preceding, and the number of species is also very great. We find in it arboreal, terrestrial, and aquatic species; and in the second of these categories some presenting almost every variety of habit which the Rodent type is capable of assuming. Naturally the families and sub-families into which it is divided are rather numerous. Mr. Alston distinguished seven family groups, the first of which is the Myoxidæ.

FAMILY V.—MYOXIDÆ.

The Dormice, which constitute this family, have generally been regarded as nearly related to the Squirrels; and certainly, although they fall under the definition of the Myomorphic section, they have a plain affinity to the Sciuridæ. In form they are Squirrel-like, and the tail is long and hairy, although not so bushy as in the true Squirrels. They have four molars on each side in each jaw (*see* figure), the front one in each series being smaller than the rest. All these teeth are rooted, and their crowns show transverse folds of enamel. The frontal bones are much narrowed; the fore limbs are small, with the thumbs rudimentary and furnished with a small flat nail; and the hind feet have five toes. The Dormice differ from all other Rodents by having the intestine entirely destitute of a cæcum. They are confined to the Eastern hemisphere, and chiefly to its temperate and colder regions; although a species of *Myoxus*, and some forms on which a special genus (*Graphiurus*) has been founded, inhabit Africa. The number of known species is only about a dozen.

MOLAR TEETH OF THE DORMOUSE.

The common Dormouse (*Myoxus avellanarius*) is an elegant little creature, about three inches long, with a somewhat bushy, cylindrical tail, two inches and a half in length. Its fur is of a light reddish-tawny colour above, becoming paler and yellowish on the lower surface. On the throat there is a small whitish mark. It is

DORMOUSE.

widely distributed in Europe, ranging from Britain and Sweden in the north to Tuscany and Northern Turkey in the south. Generally it is more abundant in southern than in northern countries, but in the south of France it is less common than either of the other two European species. Eastwards it does not extend beyond Galicia, Hungary, and Transylvania.

The Dormouse is nocturnal in its habits. During the day it sleeps in its nest or in some snug retreat, and at night comes forth in search of its food, which consists of nuts, acorns, seeds, berries, and the buds of trees and shrubs. It is particularly fond of the nuts of the common hazel, whence its specific name, and the name of "Haselmaus," which it bears in Germany; these nuts it is said to pierce and empty without plucking them or taking them out of their cups. The Dormouse lives in small societies in thickets and hedgerows, where it is as active in its way amongst the bushes and undergrowth as its cousin the Squirrel upon the larger trees. Among the small twigs and branches

of the shrubs and small trees the Dormice climb with wonderful adroitness, often, indeed, hanging by their hind feet from a twig in order to reach and operate on a fruit or a nut which is otherwise inaccessible, and running along the lower surface of a branch with the activity and certainty of a Monkey. Detached articles of food are held up to the mouth by the fore paws, after the fashion of a Squirrel. Towards the winter the Dormouse becomes exceedingly fat, and having collected a small store of food, makes for itself a little globular nest, composed of small twigs, leaves, pine-needles, moss, and grass, and within this, coiled up into a ball, passes into a torpid state.

Nevertheless, the winter sleep is not wholly uninterrupted; on mild days the Dormouse wakes up for a time and takes a little of its stored-up food. The female produces usually about four young, in the spring according to Professor Bell, in August according to Brehm; but the former writer thinks that in some cases two broods are produced in the year, as he has received from the same locality in September a half-grown Dormouse and three very young ones, evidently not more than a fortnight or three weeks old.

Of the other common European species, the Loir (*Myoxus glis*) is found only in southern regions, its range extending from Spain to Southern Russia, and passing into the neighbouring parts of Asia. It is considerably larger than the Dormouse, measuring rather more than six inches in

GARDEN DORMOUSE.

length, and has a bushy tail, in which the hairs are arranged in two rows, as in that of the Squirrel. The habits of this species are like those of the Dormouse. Fruit constitutes a portion of its diet, and it is said also to destroy and devour small birds and other animals. The Loir is a very voracious feeder, and becomes exceedingly fat in the autumn. By the ancient Roman epicures it was regarded as a dainty morsel, and they spared no pains to fatten it for the table. It sleeps during the day, and hibernates in some hole in a tree or in the ground, and the nest is formed in the former situation. The female usually produces about six young.

The Garden Dormouse, or Lerot of the French (*Myoxus nitela*), is common all over the southern and western parts of the Continent, extending northwards through Germany into the Baltic provinces of Russia. It is a little smaller than the preceding species, which, however, it resembles in its general habits; but it dwells commonly in gardens, and feeds on fruits, often doing much damage to the choicer varieties. It is a lighter and more active animal than the Loir, and is said to be even more predaceous in its habits. The female produces from four to six young, sometimes in a beautifully-made nest of her own, sometimes in the deserted or usurped nest of a Blackbird or Thrush, or in that of a Squirrel.

FAMILY VI.—LOPHIOMYIDÆ.

The importance of an animal in the zoological system by no means depends either upon its size or on its abundance in the world; its rank in the classification is decided solely by peculiarities of

organisation which distinguish it more or less from its fellows; and in many cases the creatures which are regarded with the most interest by the naturalist are those which seem most to withdraw themselves from general observation. A single genus, perhaps containing only one or two species, may, by a singular combination of characters, be so completely isolated from all the recognised allied groups that it cannot be placed in any of them, and accordingly a distinct family, possibly even an order, has to be established for its reception. Sometimes subsequent discoveries add to the number of species forming the group thus set up, and in this way the prescience of its founder is confirmed. Sometimes the group remains in its original condition, leaving us, according to circumstances, to regard the anomalous creatures of which it is composed either as a special development of their general type, or as the residue of a group which may have presented a greater variety of forms at some past period of the earth's history.

SKULL OF LOPHIOMYS.

The latter is perhaps the case with the curious little Rodent which alone forms the present family, of which its original describer, M. Alphonse Milne-Edwards, writes as follows:—"In its general aspect it somewhat resembles certain Opossums, and like these it is pedimanous;* but these are the only analogies it presents to the Marsupials, and in its dental system, as also in the rest of its organisation, we easily see that it belongs to the order Rodentia. It differs, however, from all the members of this group by characters of considerable importance; I may even say that, by some peculiarities of structure it departs from all other Mammals, and that we find in it anatomical arrangements of which we have hitherto had examples only in the class of Reptiles." After an exhaustive discussion of the characters of this curious little animal, M. Milne-Edwards comes to the conclusion that it is most nearly related to the members of the following family, and especially to the Hamsters, although he found it impossible to unite it with them. In this course he has been followed by other writers.

The general construction of the skull is the same as in the Muridæ, but from the temporal ridges thin plates are developed, which bend downwards, and articulate with similar plates springing from the malar bones, and thus completely arch over the temporal fossæ after a fashion only met with in certain reptiles, and especially in the Hawksbill Turtle (*Chelone caretta*). The whole upper surface of the skull is covered with minute but perfectly definite granules, arranged with much regularity, and these, which occur in no other Mammal, give the skull a very peculiar aspect, such as may be seen in some fishes. As in the Muridæ, there are three molars on each side in each jaw, and these are rooted and strongly tubercular; the foremost in each series having three and the others each two ridges. Without entering in detail into the peculiarities described at great length by M. Milne-Edwards, we may say that in its general structure, and especially in that of the skeleton, the animal is murine, but with a very important distinction, namely, that the collar bones, which are well developed in the Rats and their allies,

LOPHIOMYS.

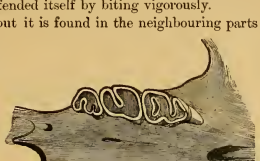
* Having the hind feet hand-like.

are here reduced, as in the Hares and Rabbits, so as to form only two small bony styles freely suspended among the muscles, and that the first toe in the hind feet, although not very long, is so attached as to be opposite to the rest, thus converting the organ into a prehensile hand which the animal uses freely in climbing. The cæcum is small.

In its external characters this animal is as remarkable as in its anatomical structure. In general appearance, as stated by its describer, it has much resemblance to a small Opossum, but the bushy tail and the peculiar arrangement of the hair on the body are met with in no Marsupials. The head is small; the general form stout; the limbs short, and the hind ones not much longer than their fellows; and the ears are of moderate size and sparingly clothed with hair. The prevailing colour is blackish-brown, but a triangular spot on the forehead, a streak under each eye, and the tip of the tail, are white; and the long hairs which clothe the body and tail are dark only in the middle, the base and tip being white, as are also a great quantity of finer and shorter hairs which form a sort of under fur. But the chief peculiarity of the coat is to be found in the arrangement of the hairs of the body. The long hairs of the middle of the back and tail, some of which are nearly three inches in length, are capable of being raised into a nearly upright position, forming a sort of crest which gives the animal a very peculiar aspect, and this crest is separated from the pendulous hair of the flanks by a sort of furrow clothed with very peculiar hair of a greyish-tawny colour. These hairs are unlike any others known to occur among Mammals. The apical part is of the ordinary construction; but the following portion down to the base is "very rugose, and presents a spongy aspect, due to the interlacing, and, so to speak, felting of a multitude of epidermic filaments emanating from radiate cells, which constitute a perfect network of irregular meshes. Within the sort of sheath thus formed longitudinal filaments which break up into bundles of fibrils are to be seen."

Very little is known as to the habitat of this animal, which M. Milne-Edwards has named *Lophiomys Imhausi*, the former name referring to the crested character of the back, the second commemorating the person who first brought the creature to the notice of naturalists. M. Imhaus, stopping for a few hours at Aden on his way home from Réunion, saw a living specimen of this Rodent in the possession of a negro from whom he bought it, but could learn nothing as to its origin. He inferred, however, that it had not been brought very far, and that its native country was either Southern Arabia, or some region in Abyssinia, or Nubia, on the other side of the Red Sea. This specimen was brought to France, and lived for about a year and a half in the Garden of Acclimatization in the Bois de Boulogne, where it fed upon maize, vegetables, and bread, slept during the day, and climbed with ease upon chairs and other convenient objects by the aid of its hinder hands. It never took its food in the fore-paws to carry it to the mouth as so many Rodents do. When irritated it elevated the crest right down to the end of the tail, and defended itself by biting vigorously.

It is doubtful whether the *Lophiomys* inhabits Arabia, but it is found in the neighbouring parts of Africa. Professor Peters described the skull of the animal as representing a new generic type under the name of *Phractomys æthiops*. His specimen was obtained by Dr. Schweinfurth from the tombs of Maman, north of Kassala, in Upper Nubia. A third specimen has been brought from Keren in the Bogos country, and a fourth from the Erkanid mountains between Suakim and Singat.



MOLAR TEETH OF THE BLACK RAT.

FAMILY VII.—MURIDÆ.

We come now to the largest and most typical family of the Rodents: that, namely, which includes the Rats and Mice and their numerous allies. Mr. Wallace estimates the number of known species at 330, which is probably within the mark. All these forms agree in the following characters:—The lower incisors are compressed; the molars are usually three in number on each side in each jaw, in one genus only two in the lower or in both jaws, and in another four in both jaws. They are rooted or rootless, tubercular or flat, with folds of

enamel; the malar bone is short and slender, generally reduced to a mere splint between the maxillary and squamosal processes of the zygomatic arch; the thumb is rudimentary, but often furnished with a small nail; and the tail is generally scaly, with a few scattered hairs, densely hairy only in a few species.

As might be expected in so large an assemblage of species, the variety of forms is very great among the Muridæ, but broadly, the common Rats and Mice, which are only too well known to most of us, may serve as characteristic types of the whole series. The family, however, includes jumping forms, swimming forms, arboreal forms, and burrowing forms, in which the peculiarities of the life-habits are very distinctly indicated by the external appearance of the creatures. In their distribution the Muridæ are almost absolutely cosmopolitan, the family being represented in

BROWN RAT.

every part of the world, with the sole exception of the islands of the Pacific Ocean. Australia possesses about thirty species of the family. New Zealand, at the time of its discovery, harboured a Rat, known as the Forest Rat, or Maori Rat, which was a favourite article of food with the natives, and is now almost extinct. It was proved by Capt. Hutton to be identical with the Black Rat (*Mus rattus*), and was probably introduced by the ancestors of the Maoris. Certain species also, such as the common Brown Rat and Mouse, are now perfectly cosmopolitan in their distribution, having accompanied man in all his migrations on the surface of the globe.

The Rat and Mouse form the types of a great sub-family, MURINÆ, which have the molars rooted and tuberculate when young, the infra-orbital opening high and perpendicular, widest above, and the lower root of the zygomatic maxillary process flattened into a perpendicular plate. They possess no cheek-pouches, have the fore and hind limbs approximately equal in length, the thumb rudimentary, and the tail nearly naked, covered with scaly rings. The genus *Mus*, to which our household pests belong, includes upwards of one hundred species, scattered over most parts of the Eastern Hemisphere, and living sometimes chiefly in the neighbourhood of human habitations, granaries, &c., where they often feed indifferently upon animal and vegetable substances, sometimes in the open country, and feeding

almost exclusively upon the latter. The common Brown Rat (*Mus decumanus*), sometimes called the Norway Rat, which is almost too well known to need description, is not a native of Great Britain, but was certainly introduced there by commerce, probably from some southern or eastern country—perhaps, as Pennant thinks, from the East Indies. Haunting ships in great numbers, it has now been introduced into all parts of the world, and it is quite impossible to ascertain its original habitat. It was known in Asia long before it made its appearance in Europe; and its passage into Russia is fixed by Pallas in the year 1727, when, he says, after an earthquake it swam across the Volga from the countries bordering the Caspian. Its first appearance in France and England is said to have occurred about the middle of the last century.

From its great fecundity and determined ferocity of disposition, the Brown Rat has become a great pest wherever it has taken up its abode. "It digs," says Professor Bell, "with great facility and

BLACK RAT.

vigour, making its way with rapidity beneath the floors of our houses, between the stones and bricks of walls, and often excavating the foundations of dwellings to a dangerous extent. There are many instances of their fatally undermining the most solid mason-work, or burrowing through dams which had for ages served to confine the waters of rivers and canals." It is almost impossible to keep them out of our houses, and, once in, there is no end to the mischief they do. Their ferocity is very great; and although they will, if possible, retreat from a powerful enemy, they will fight in the most savage fashion when they cannot escape.

Although not averse to a vegetable diet—as those who have to do with corn and seeds, whether in the field or the store-house, know to their cost—the Brown Rat evinces a decided preference for animal food, which he consumes of all kinds and in all states. The case of the horse slaughter-houses of Montfaucon, near Paris, is well known; here, the carcases of all the Horses killed during the day, sometimes to the number of thirty-five, would be picked to the bone by the next morning; and one main argument against the removal of the establishment to a greater distance from the city was that these swarms of ferocious vermin would be left without means of support, and would become a complete pest in the neighbourhood. That such an apprehension was not unfounded is proved by several instances recorded of the escape of Rats from wrecked ships upon small islands. In the course of

a few years they exterminated every other living thing. Professor Bell, on the authority of the late Mr. Robert Stephenson, relates the following instance of the extreme ferocity of the Rat when driven by hunger:—"In a coal-pit," he says, "in which many Horses were employed, the Rats, which fed upon the fodder provided for the Horses, had accumulated in great multitudes. It was customary in holiday times to bring to the surface the Horses and the fodder, and to close the pit for the time. On one occasion, when the holiday had extended to ten days or a fortnight, during which the Rats had been deprived of food, on re-opening the pit, the first man who descended was attacked by the starving multitude, and speedily killed and devoured." Stories are also told, with what truth we do not know, of the occurrence of similar catastrophes in the sewers of Paris and London, where, as is well known, Rats abound.

The Brown Rat breeds several times during the year, and produces as many as ten, twelve, or fourteen young ones in a litter. Its general length is about nine inches. It may be distinguished from the old English Rat, which it has displaced in most localities, by its greyish-brown colour and by the comparative shortness of its ears, which, when pressed down, do not reach the eye.

The Black Rat (*Mus rattus*), or old English Rat, as it is sometimes called, agrees closely in its habits with the Brown Rat. It is smaller than the Brown Rat, measuring only about seven inches in length, but has a comparatively much longer tail and larger ears, which, when pressed forward, cover the eyes. Its colour above is greyish or brownish-black, and the lower parts are dark ash colour. Although the Black Rat has generally been compelled to give way before its larger and more vigorous competitor, it is still widely dispersed, but not in such numbers as formerly, in Europe. Its native country was probably Southern Asia. Nearly allied to it, if indeed specifically distinct, is the Egyptian Rat (*Mus alexandrinus*). Both these Rats are said to keep more to the upper parts of houses than the Brown Rat.

Although the true Mice are very nearly allied to the Rats, of which they are copies on a small scale (and some of them, at any rate, are as destructive in their way as their larger relatives), they do not excite by any means the same sentiments of disgust with which Rats are generally regarded; ladies, indeed, will sometimes scream at the mere sight of a Mouse, but most of them will admit that, apart from its predatory habits, it is an elegant little creature. The Common Mouse (*Mus musculus*) seems to be as completely associated with man as the Rat, and has accompanied him in his wanderings to all parts of the world. It is, however, said not to occur in the Sunda Islands. Of its general appearance and habits we need say nothing; they are too familiar to need description. But besides haunting our houses, the Mouse takes up its abode in the rick-yard, and here its devastations are often very serious. The Mice live in the ricks, through which they make passages in every direction, and their fecundity is so great that several bushels of Mice are often destroyed during the removal of a single rick. The Mouse breeds all the year round, and usually produces five or six young at a birth, so that its rapid increase under favourable circumstances is easily understood. Several varieties of the species are well known, especially the Albino form, or White Mouse, which is such a favourite pet with boys. The Common Mouse in England is sometimes patched with white, and we sometimes see in the shops Pied Mice, which are said to be of Indian origin. A pale buff variety is also sometimes met with; and during the removal of a rick some years ago, it was found to be infested by a breed of Mice with a naked wrinkled skin, to which the name of Rhinoceros Mice was given at the time.

Besides these more or less domestic species, there are in Britain two other representatives of the genus *Mus*, which do not generally frequent houses. One of these is the Long-tailed Field Mouse (*Mus sylvaticus*), sometimes called the Wood Mouse, an exceedingly pretty little creature, rather larger than the Common Mouse, and having a proportionally longer tail. It measures about four inches in length, and the tail is about as long as the body; its colour is yellowish or yellowish-brown on the upper surface, whitish beneath; and the tail is brown above and white beneath. This species is found all over the temperate parts of Europe and Asia, living in the fields and gardens, where it takes up its abode, either in some small cavity under the root of a tree, in the deserted runs of the Mole, or less commonly in a little burrow excavated by its own labour. It feeds chiefly upon grain and seeds, of which it lays up a considerable store for winter use in its subterranean dwelling, and in this way does considerable damage to the crops. The Field Mouse does not, however, strictly

HARVEST MICE.

confine itself to a vegetable diet, but under circumstances of privation will attack and devour smaller and weaker animals, not even sparing its own species. It breeds more than once in the year, and produces from seven to ten young in each litter. It is easily tamed, and soon becomes familiar.

The remaining British species, the HARVEST MOUSE (*Mus minutus*), is the smallest of the British quadrupeds, with the exception of the Lesser Shrew (*Sorex pygmæus*). The Harvest Mouse is to be found in most parts of England. It also occurs in Scotland as far north as Aberdeenshire; and in Ireland, but very rarely. On the Continent its range extends over nearly the whole of Europe, from Russia in the north to Italy in the south. It is well known in Siberia, and occurs abundantly in the steppes near the Caucasus.

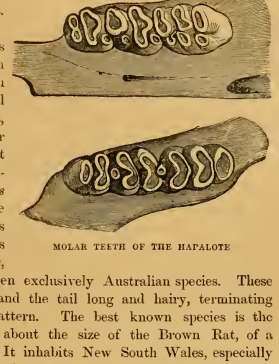
The total length of this pretty little Mouse is about five inches, of which nearly one-half is made up of the tail. In it the eyes are less prominent than in the common Field Mouse, and the ears considerably shorter in proportion. Its colour on the upper surface is bright reddish-brown, and below pure white, the two colours being sharply separated. During the summer, the Harvest Mouse associates with the other Field Mice in corn-fields, and with them is very frequently carried in the sheaves of corn to rick-yards and barns, where it then takes up its abode for the autumn and winter, and, like other Mice, multiplies very rapidly, and no doubt does a good deal of mischief. The less fortunate individuals who are left behind in the fields retreat to little burrows for protection from the inclemency of the winter, which they pass in a state of at least partial torpidity; and to provide against exigencies they lay up in their dwellings a small store of food, to which they can have recourse when a fine day recalls them for a time to activity. Those which have been introduced into ricks and barns are, of course, liberally provided for, and they show their gratitude by remaining awake all the winter, as if on purpose to consume their abundant provender. In the open field their food consists of corn and the seeds of grasses and other plants, but also to a considerable extent of small insects.

In its movements the Harvest Mouse is wonderfully agile. On the ground it runs very rapidly; and it climbs upon shrubs and plants as cleverly as a Monkey, running out upon the thinnest twigs with the greatest confidence, and climbing up stalks of grasses so thin that they bend nearly to the ground with its weight. In these operations the long slender tail comes into use, as its extremity is prehensile, and can be twisted neatly round the small stalks and branches over which the little climber is making its way. From its lively habits, and the elegance of its form, the Harvest Mouse is a very interesting pet.

The Harvest Mouse breeds several times during the year, producing from five to eight or nine young at a birth, and provides for them one of the prettiest cradles formed by any Mammal. It is placed, according to the locality, upon several grass-leaves split and interwoven with the other materials, or suspended at a height of from eighteen inches to three feet above the ground, upon the twigs of some shrub or between several stalks of corn or strong grasses. It is egg-shaped, or nearly round, about the size of the egg of a Goose, and is composed externally of slit leaves of the reeds or grasses among which it is formed, each leaf being carefully divided longitudinally by the sharp teeth of the little architect into six or eight thread-like portions, which are then all woven together, so as to produce a firm structure. The interior is lined, or rather stuffed, with all sorts of soft vegetable substances, so that it has been a question with many observers how the mother could get at all the members of her family to suckle them, and how the nest could contain them all as they began to increase in bulk. The young usually remain in the nest until they can see; but as soon as they are able to provide for themselves, the mother takes them out, gives them some practical instructions in the art of living, and then leaves them to their own devices. According to Brehm, as these Mice increase in age they improve in the art of nest-building.

Besides these few species, a multitude of Rats and Mice, belonging to the same genus, occur as natives of nearly all parts of the world, but in their habits they agree in general with the British species. India harbours a considerable number, among which we may mention the BANDICOOT RAT (*Mus bandicota*), a large species, which inhabits the Indian and Malayan peninsulas, and is very destructive in plantations; and the TREE RAT (*Mus arboreus*), a native of Bengal, seven or eight inches in length, which lives partly on grain, of which it lays up stores in its nests, and partly on young cocoa-nuts, which constitute its favourite food, and in search of which it climbs the trees. This

species builds a nest on cocoa-nut trees and bamboos, and occasionally makes predatory visits to the houses. The STRIPED MOUSE (*Mus barbarus*) is remarkable for its coloration, its ground colour being a bright yellowish-brown or reddish-yellow, adorned with several longitudinal blackish-brown streaks. This elegant Mouse inhabits Northern Africa, especially in stony places. It is very abundant in Algeria.



MOLAR TEETH OF THE HAPALOTE

Nearly allied to the true Mice are numerous forms more restricted in their distribution, which have been formed into distinct genera. Thus *Pelomys fallax*, in which the incisors are grooved, the tail short, and the first and fifth toes of all the feet shorter than the three middle ones, is peculiar to Mozambique; *Acanthomys*, in which the fur is mixed with flattened spines, is an African genus; whilst *Echinothrix*, which has a somewhat similar coat, is Australian. Madagascar possesses two peculiar genera, *Nesomys* and *Brachytarsomys*, the former having some relation to the American Murinæ, the latter remarkable for the shortness of the hind feet; and in Australia, besides the genus already mentioned, and one or two species of true *Mus*, we find the genus *Hapalotis* represented by about thirteen exclusively Australian species. These animals have the hind limbs rather long, the ears large, and the tail long and hairy, terminating in a tuft. The molar teeth also exhibit a peculiar pattern. The best known species is the WHITE-FOOTED HAPALOTE (*Hapalotis albipes*), an animal about the size of the Brown Rat, of a smoky brown colour, with the belly and the feet white. It inhabits New South Wales, especially in the mountainous parts. The animals of this genus were formerly regarded as allied to the South American Chinchillas and Viscachas.

The American Murines all belong to a group to which the name of Sigmodontes has been given, because their molar teeth, which in the young state have two tubercles in each transverse row (instead of three, which is the usual number in the preceding forms), when ground down by use, show some S-like patterns in the enamel folds in place of transverse ridges. The greater number of the species belong to the genus *Hesperomys* (Western Mouse), which is represented in both divisions of the American continent, and has been divided by authors into several sub-genera. The WHITE-FOOTED, or DEER MOUSE (*Hesperomys leucopus*) is perhaps the best known of all the species, and its varieties, or rather local permanent races, are distributed all over the continent of North America. The fur shows various brownish or greyish tints above; and the lower surface, with the feet up to the wrist and ankle, is snow-white. What Dr. Coues gives as the normal colour of typical specimens is a rich fawn, with a darker streak along the back: but he says that this is shown by not more than one example in six. The tail is generally white beneath. The length of the head and body is about three inches; the tail varies considerably in length. The White-footed Mouse is nocturnal in its habits, and feeds to a great extent upon corn, of which, with acorns and other nuts, it lays up stores for winter use. It lives a good deal upon trees, taking up its abode in the deserted nest of a Squirrel or of some small bird. When it constructs its own nest the little fabric is placed in a bush at from five to fifteen feet from the ground, and is very neatly constructed, usually of fine moss and strips of bark. In some localities it burrows in the ground. The GOLDEN or RED MOUSE (*H. aureolus*), which resembles the preceding species in form and size, has the fur of the upper surface golden-cinnamon colour, and the lower parts yellowish-white. It inhabits the Central and Southern States of the North American Union. The RICE-FIELD MOUSE (*H. palustris*), which has been placed in a distinct genus (*Oryzomys*), is a larger species, sometimes attaining the size of a small Rat. This is found in the Southern States, chiefly along the coast, and in rice-fields, where it is exceedingly abundant and does considerable damage. It is eminently aquatic in its habits. The AMERICAN HARVEST MOUSE (*Ochetodon humilis*) closely resembles the preceding species, but differs from them in a rather remarkable character. It has the upper incisor teeth grooved, a peculiarity which occurs also in the South American Rats of the genus *Reithrodon*.

The American Harvest Mouse inhabits the Southern States, and extends northwards as far as Iowa and Nebraska.

The Florida Rat, or Wood Rat (*Neotoma floridana*), is a widely distributed species in the United States, inhabiting especially the southern portion, but extending northwards as far as New York and Massachusetts. It measures from six to nine inches in length, with a tail from four to six inches long. In its coloration it presents a general resemblance to the common Brown Rat, but is brighter, especially on the sides; the lower surface is white. According to Audubon and Bachmann, the habits of this species vary considerably in different localities. These authors say that "in Florida they burrow under stones and the ruins of dilapidated buildings. In Georgia and South Carolina they prefer remaining in the woods. In some swampy situations, in the vicinity of sluggish streams, amid tangled vines interspersed with leaves and long moss, they gather a heap of dry sticks, which they pile up into a conical shape, and which, with grasses, mud, and dead leaves, mixed in by the wind and rain, form, as they proceed, a structure impervious to rain, and inaccessible to the Wild Cat, Raccoon, or Fox. At other times their nest, composed of somewhat lighter materials, is placed in the fork of a tree." This species is very active and Squirrel-like in its habits. It feeds on grain, seeds, and fruits, and sometimes makes a meal of a Crayfish or a Frog. There are from three to six young in each litter, and two litters in the year. The young animals in very early days continue to adhere to the teats of their mother, even when she is walking about outside the nest, and even at a later period they will cling to her sides and back, after the manner of some Opossums. The female seems but little inconvenienced by this burden, and shows great affection for her family, defending them even at the risk of her own life. A nearly-allied, but smaller species, the Bushy-tailed Wood Rat (*N. cinerea*), inhabits the western and north-western parts of America, also extending eastward to Hudson's Bay, and southward to New Mexico and California. The Cotton Rat (*Sigmodon hispidus*), another inhabitant of the Southern States and Mexico, ranges southwards to Vera Cruz and Guatemala.

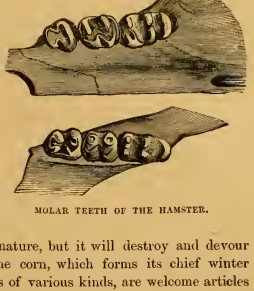
Besides several species of *Hesperomys*, South America possesses various Murine animals, which have been placed in special genera. Among these the most remarkable are those of which Mr. Waterhouse formed his genus *Reithrodon*, as these, although true Murines, have a very Rabbit-like character, and further present the peculiarity of having the upper incisors grooved. They have the profile much arched, the eyes large, the ears hairy, and the first and fifth toes of the hind feet very short. The tail is well clothed with hair. The Rabbit-like Reithrodon (*R. cuniculoides*) inhabits Patagonia, where it was discovered by Mr. Darwin. It is of a yellowish-grey colour, mixed with black, with the throat and belly pale yellow, and the rump and feet white. The tail is about half the length of the head and body, dusky above, white beneath. The length of the head and body is six inches and a half. Two other species are described: one (*R. typicus*) from the La Plata; the other (*R. chinchilloides*) from the Strait of Magellan.

HEAD OF THE RABBIT-LIKE REITHRODON.

The Hamsters, forming the sub-family Cricetinæ, are very nearly related to the true Mice and Rats, but differ from them at the first glance by their possession of large internal cheek-pouches, those organs being entirely wanting or very small in the Murinæ. Their molars, three in number in each series, are also tuberculate when young and regularly rooted. As age advances they become more and more worn away, so as to exhibit folds of enamel. They are stoutly-built rat-like animals, generally with short tails, with the upper lip cleft, and with short limbs, of which the hinder have five, and the anterior four, toes, the thumb being represented by a small wart. The Hamsters are confined to the Old World, and chiefly inhabit the temperate parts of Europe and Asia; two or three species occur in Africa. They live generally in corn-fields, where they dig deep burrows with numerous chambers, into which they can retreat to take their repose, and in which they pass the winter, previously, however, taking care to lay up a good store of provisions in some of the chambers of their domicile.

HAMSTERS.

The best known species is the HAMSTER (*Cricetus frumentarius*, *see* Plate 28), a rather pretty little beast, of about ten inches long, with bright, prominent, black eyes, short, membranous ears, and a tapering hairy tail, about two inches and a half in length. The fur, which is thick and somewhat lustrous, is usually of a light yellowish-brown colour above, with the snout, the neighbourhood of the eyes, and a band on the neck reddish-brown, and a yellow spot on each cheek; the lower surface, the greater part of the legs, and a band on the forehead are black, and the feet white. Many varieties occur. This Hamster is widely distributed, ranging from the Rhine, through Europe and Siberia, to the Obi; and in most localities where it occurs it appears in great numbers, and causes great injury to the crops. Its burrows are exceedingly spacious, and consist of numerous passages and chambers. In its temper it is exceedingly irascible, and at the same time very courageous, defending itself bravely against its enemies, and standing boldly on the defensive the moment any danger appears to threaten it. Its diet is by no means of a purely vegetable nature, but it will destroy and devour all sorts of small animals that come in its way. Besides the corn, which forms its chief winter provender, green herbage, peas and beans, and roots and fruits of various kinds, are welcome articles of diet, and in confinement it will eat almost anything.



MOLAR TEETH OF THE HAMSTER.

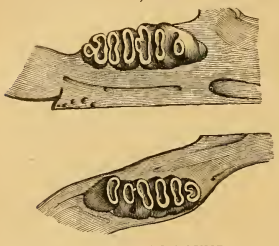
The Hamsters pass the winter in their burrows in a torpid state, but waken up very early in the spring, generally in March, but frequently in February. At first they do not open the mouths of their burrows, but remain for a time subsisting on the stores laid up during the preceding autumn. The old males make their appearance first, the females about a fortnight after them, the latter about the beginning of April. They then set about making their summer burrows, which are not so deep or so complicated as the winter dwellings; and shortly afterwards the sexes pair. The young are produced twice in the year, in May and July; their number varies from six to eighteen. They have teeth when first born, and their development as babies is very rapid. Their eyes open in little more than a week after birth, and in another week they begin to burrow in the ground, and then their hard-hearted parent drives them off to take care of themselves.

The other species of this sub-family generally very closely resemble the Hamster, both in appearance and manners. Most of them are found in Central Asia and Siberia, extending southwards as far as Persia and South Tartary. *Cricetus songarus* has been obtained at Kumaon. The recorded African species belong to two peculiar genera: they are *Saccostomus lapidarius* and *fuscus*, and *Cricetomys gambianus*.

Other African forms constitute the small sub-family of the TREE MICE (*Dendromyinæ*), which are entirely confined to the southern portion of the continent. They are characterised by having the incisors rounded and grooved in front, the infra-orbital opening not narrow below, and the coronoid process of the lower jaw very small. The ears are clothed with hairs; and the feet, which are five-toed, are furnished with long claws, which are serviceable to the little rat-like animals in climbing up the trunks of trees. The BLACK-STREAKED TREE MOUSE (*Dendromys mesomelas*) is a rather pretty little species, of a greyish colour, with a black line down the middle of the back. It is slender in form, with a long, scaly tail, rounded ears, and the two outer toes in each foot shorter than the rest. *Steatomys pratensis*, from Mozambique, is stouter in form than the preceding, and has a short, densely hairy tail; and in *Lophuromys ater*, from the same locality, the incisors are not grooved, and the fur is developed into fine flattened bristles.

The GERBILLES (*Gerbillinæ*) are distinguished from all other Muridæ (although approached by *Hapalotis*) by the great length of the hind limbs, which are converted into powerful leaping organs, somewhat as in the Jerboas and Kangaroos, although not quite to the same extent. Like all the preceding forms, they have the molars furnished with roots, but not with tuberculate crowns, these being divided into transverse plates formed by separate elliptical or rhomboidal coats of enamel. The incisor teeth are narrow, the infra-orbital opening as in the Murinæ, and the tail long and hairy.

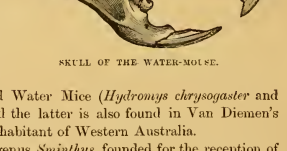
The Gerbilles are plump little animals, with a short neck, a broad head, and a pointed muzzle. The feet are five-toed, but the thumb on the fore feet is reduced to a mere wart-like process with a flat nail. They are confined to the Eastern hemisphere, and, indeed, to the African continent, the south of Asia, as far as India, and the south-east of Europe, where they live both in cultivated districts and in the driest deserts, and often occur in great numbers, when they may cause considerable damage to the neighbouring crops. They shelter themselves during the day in shallow burrows, and come forth in the evening in search of their food, which consists chiefly of grain and roots. They store up great quantities of the ears of corn in their subterranean dwellings, and in many places the poorer inhabitants search after these stores, and by digging them out procure a good supply of grain. They are very prolific, the females producing large families several times in the year.



MOLAR TEETH OF THE GERBILLE.

Several other forms of Muridæ, with rooted molars, have been distinguished, and all are inhabitants of the Eastern hemisphere. The genera *Phlœomys* and *Nesokia*, each including a single species, form the group PHLÆOMYINÆ, characterised by having broad incisors and the molars divided by transverse plates of enamel. The characters of the skull are as in the Murinæ. *Phlœomys Cumingii* is from the Philippine Islands; *Nesokia Griffithii* inhabits Northern India. *Platacanthomys lasiurus*, the only known species of the group PLATACANTHOMYINÆ, resembles a Dormouse in its form, and is nearly allied to the preceding species, but has the fur of its back mixed with long, flattened, bristle-like spines. It is a native of the Malabar coast.

The WATER MICE (*Hydromyinæ*) are of particular interest, as being a small group, exclusively confined to the Australian region, and presenting the exceptional character among the Rodents of having only two molars on each side in each jaw. These teeth, are rooted, and divided into transverse lobes by ovate enamel lobes; the front tooth is much larger than its fellow. The *Hydromys* are small rat-like animals of slender form, with long tails, rather densely clothed with short hairs, and short limbs. The hind feet have much stronger claws than the fore feet, and their toes are partially webbed. Five species of this group are known from Australia and Van Diemen's Land, where they inhabit the banks of the streams. The best known are the Yellow-bellied and the White-bellied Water Mice (*Hydromys chrysogaster* and *leucogaster*), both of which inhabit New South Wales, and the latter is also found in Van Diemen's Land. The Sooty Water Mouse (*H. fuliginosus*) is an inhabitant of Western Australia.



SKULL OF THE WATER-MOUSE.

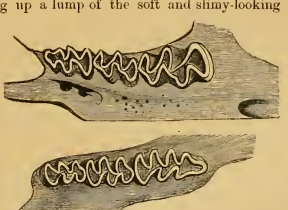
In the SMINTHINÆ—a group which includes only the genus *Sminthus*, founded for the reception of a rat-like Rodent (*S. vagus*) first discovered in the Crimea, but now known to range from Hungary, Finland, and Sweden, through Russia to the banks of the Irtisch and Yenisei, and into Tartary (Bokhara)—we find another exceptional character of the molar teeth. There are four of these teeth on each side both above and below, the first and fourth of which are much smaller than the intervening ones. In this animal the ears are rather long and pointed, the legs are rather short, and the tail is about as long as the body, and clothed with short hairs.

TEETH OF SMINTHUS.

In the remainder of the Muridæ, the molars, which are again only three in number on each side, are generally rootless, although occasionally the growth of the teeth stops and they close up below. The molars are composed of triangular prisms placed alternately. Two groups are thus characterised, namely, the Voles and the Zokors.

The Voles (*Arvicolinæ*), which, next to the true Rats and Mice, form the most important group of Muridæ, are represented in the northern parts of both hemispheres. The brain-case in these animals is rhomboidal when looked at from above, the frontal region of the skull is much contracted, and the zygomatic arch stands out very far. The infra-orbital opening is as in the Murinæ. The molars are so constructed of alternating triangular prisms that the whole margin is enclosed by deep angular folds of enamel. These are mouse- and rat-like Rodents of a rather stout build, with the limbs and tail of moderate length, or short, and the latter more hairy than in the true Murines. The ears are short, often nearly concealed beneath the fur.

The true Voles (genus *Arvicola*) number about fifty known species, which have been arranged by various writers under a considerable number of sub-genera, generally corresponding to differences in mode of life. Three species, representing three of these groups, are found in Britain, and may serve to illustrate the natural history of the Voles. The largest of these is the well-known Water Vole, or Water Rat, as it is more commonly called (*Arvicola amphibius*), an animal rather smaller than the Common Rat, and having, like all the Voles, the muzzle considerably blunter, and the tail a good deal shorter and more hairy. Although thoroughly aquatic in its habits, the feet of the Water Vole are not webbed; they have five toes, but the thumb in the fore feet is very short. The general colour of the fur is reddish-brown, mixed with grey on the upper surface, and yellowish-grey beneath; the ears are nearly concealed in the fur; and the incisor teeth are deep yellow in front, and very strong, presenting a considerable resemblance to those of the Beaver, to which great Rodent the Voles were formerly considered to be related. It is very widely distributed, being found in all parts of Europe, and stretching right across Central and Northern Asia, to China, the Amoor region, and the Sea of Okhotsk. In Ireland, however, it is not found. Its habits vary a little in different localities, but in general it haunts the banks of rivers, in which it burrows to a considerable distance. In the water it is very active, swimming and diving with the greatest facility, and it is here that it seeks its food, which appears to consist exclusively of vegetable substances. Professor Bell says:—"A decided preference is shown, during the summer months, for the inner or concealed part of some species of sword-flags, which is very succulent and sweet-tasted. As this portion is usually below water, the animal gnaws the plant in two near its root, when it rises to the surface, and being conveyed to some sound footing, is consumed at leisure. In default of its more favourite food, it will make a satisfactory meal on the common duckweed. Only the green and fleshy leaf is eaten, the roots and other fibrous parts being rejected. While feeding on this plant, the creature sits like a Squirrel on its haunches near the water's edge, and taking up a lump of the soft and slimy-looking mass in its fore paws, eats a small part only, and letting the remainder fall, takes up some more in the same manner." The accusation sometimes brought against the Water Vole of eating worms and insects, and even of destroying fish-spawn, young fishes, and even young ducks, seems to be entirely unfounded. In the winter the Water Voles will feed on turnips, mangel-wurzel, and other roots, and also upon the bark of osiers and willows, to which they do considerable damage; and in some localities they appear to frequent gardens at all seasons of the year, burrowing in the ground, and feeding luxuriously upon the produce of the gardener's labour. Their greatest activity is in the twilight, but in quiet situations they are to be seen abroad during the day. The female produces from two to six young at a litter: twice in the year in Britain, according to Professor Bell; three or four times in the course of the summer, according to Brehm and other Continental naturalists.



MOLAR TEETH OF THE WATER RAT.

A second British species is the Field Vole, or Short-tailed Field Mouse (*Arvicola agrestis*), which is less than half the size of the Water Vole, and has the tail only about one-third the length of the body, instead of half that length. In the general form of the head and body the two species are a good deal alike, but the ears project farther beyond the fur in the Field Vole. The general colour of this species is greyish-brown, becoming tinged with reddish or yellowish on the sides; the

lower surface is pale grey or dirty white, and the tail is brown above and greyish beneath. The Field Vole is a very abundant species in the northern and central parts of Europe, but is wanting in Ireland and south of the Alps and Pyrenees. It is usually found in damp places, especially in meadows in the neighbourhood of woods and copses, where it forms burrows of considerable extent. Its food consists almost exclusively of vegetable substances, such as roots and herbage, and in times of scarcity it will climb up trees and bushes to feed on the tender parts of the bark. In case of necessity, however, it does not disdain animal food, but will eat insects and meat, and even sometimes kill and devour smaller individuals of its own species. It breeds three or four times in the year, producing from four to six young at a birth, in a small round nest made of moss and leaves, among the roots of the herbage in some hollow of the ground. Their increase, which would otherwise be very formidable, is checked by the smaller predaceous beasts and birds, such as the Weasel, the Kestrel, and the Owls,

SOUTHERN FIELD VOLE.

which destroy them in great numbers. The Bank Vole (*Arvicola glareolus**), the third British species, which is chestnut-coloured, with white feet and with a longish tail, closely resembles the preceding species in its habits, but feeds rather on fruits and roots than on herbage, and is far more addicted to a diet of animal food, freely devouring insects, worms, snails, and even young birds and carrion. It is pretty generally distributed over Europe, but not so uniformly as the Field Vole, which it even exceeds in fecundity, the females producing from four to eight young three or four times in the year, in a nest constructed of grass and moss placed in a hollow of the surface of the ground among dense herbage.

The Continent of Europe is inhabited by several other species of Voles, among which we may notice the little Southern Field Vole (*Arvicola arvalis*), which more or less completely takes the place of our common Field Vole in Southern Europe, but also extends over the whole of Central Europe, and into Western Asia. Several of these species, and others to which we cannot specially refer, ascend to considerable elevations on the mountain-sides, but at least one species,

* See *Arvicola rutilus*, p. 117.

the Snow Mouse (*Arvicola nivalis*), lives on the Alps and Pyrenees, at elevations of 4,000 feet and upwards, being most abundant about the limit of perpetual snow, where it not only resides during the short period of summer, when some portion of the surface is freed from its snowy covering, but actually throughout the winter, buried under the snow, through which it makes its way in search of the roots of plants. The Root Vole (*Arvicola œconomus*) is a large and abundant Siberian species, the range of which extends from the Obi to Kamstchatka. This and some other northern species often migrate in great bodies, after the fashion to which we shall have to refer when speaking of the Lemmings.

In North America, it would appear from Dr. Coues' monograph, there are about a dozen distinct species of Voles. One of them, confined to the northern parts of the Continent, he identifies with the *Arvicola rutilus* of the Old World, which he regards as a circumpolar species. South of a line running from sea to sea, a little north of the boundary of the United States, comes another form, *A. Gapperi*, which is regarded as a sub-species of *A. rutilus*, to which *A. glareolus* (*see* p. 116) is considered to stand in a similar relation. The most abundant North American species is the Meadow Mouse (*A. riparius*), which is distributed, apparently, over the greater part of the Continent, and takes the place of the Field Vole. On the prairies there is a peculiar species (*A. austerus*), a sub-species of which (*A. curtatus*) is found in the Western territories as far as California; the Pine Mouse (*A. pinetorum*) inhabits the country east of the Mississippi; and the genus is represented in Mexico by one species (*A. quasiater*). The Voles are most numerous and abundant in the northern and north-western parts of North America.

Another American species is the Musquash, Musk-Rat, or Ondatra (*Fiber zibethicus*), which constitutes a genus distinguished from the true Voles by having the tail compressed and nearly naked, the hinder toes united by short webs, and fringed with long hairs, and the enamel folds of the molars united by a line running down the middle of the tooth. The form of the animal is thickset, and in this respect, as in its aquatic habits, it resembles the Beaver, to which it was formerly supposed to be nearly allied. The head is short and broad, the ears project very little beyond the fur, the hind limbs are longer than the fore legs, and terminate in five toes with strong claws, while the fore limbs have only four toes and a wart-like thumb; the fur is very thick and shiny, and the colour is usually brown above and grey below, with the tail, which is nearly as long as the body, black. The fur is well known in commerce. The length of the head and body of a full-grown male is about twelve inches. The name Musk-rat, often given to this species, refers to the musky odour diffused by the secretion of a large gland situated in the inguinal region.

The Musquash, which may be described as a large Water Rat, inhabits all the suitable parts of North America, from the thirteenth to the sixty-ninth degree of north latitude, and is most abundant in the Canadian region, which offers it peculiarly favourable conditions of life in the multitude of rivers and lakes, upon the banks of which the Musquash always takes up its abode. It is a nocturnal animal, passing the day in concealment, and coming forth with the twilight to seek its nourishment, and amuse itself with its fellows. In the water it displays wonderful activity, and, in many respects, presents much resemblance to the Beaver. Curiously enough, the parallelism of habits holds good to a certain extent, even in the construction of their dwellings. The Musquash generally lives in a burrow dug out of the bank of the stream in which he disports himself, and consisting of a chamber with numerous passages, all of which open under the surface of the water. But, under certain conditions, especially in the north, he builds himself a house of a rounded or dome-like form, composed of sedges, grasses, and similar materials, plastered together with mud, and supported upon a mound of mud of sufficient height to raise it above the water. The house contains a single chamber from sixteen inches to two feet in diameter, and is entered by a passage which opens at the bottom of the water. Other passages are said to issue from this, and to lead down into the ground under the bottom of the water; these are made by the animal in his search for the roots of water-lilies and other aquatic plants, which constitute a great part of his nourishment. The Musquash also seeks provisions on land, and in this way often does much mischief in gardens. Fresh-water mussels also form a part of its diet. It passes the winter in its house, which it then furnishes with a soft bed of leaves, grasses, and sedges, and, according to Audubon, ventilates by covering the middle of the dome only with a layer of similar materials, through which the air can pass. Of the propagation of the Musquash very little seems to

MUSQUASH.

be known with certainty. They pair in April and May, and the female produces from three to six young at a birth; but whether this takes place once or several times in the course of the summer is a matter of doubt. They are captured in fall-traps baited with apples, or by traps set at the mouth of their burrows. The Indians sometimes spear them in their houses.

The LEMMING (*Myodes lemmus*) is one of the most remarkable of the Muridæ, on account of the great migrations which it performs, apparently with no special object. In Norway, where it is best known, they make their appearance in the cultivated districts in such enormous numbers, and so suddenly, that the peasants have always believed them to fall from the clouds. The Lemming is a Vole-like animal, about six inches long, of which the tail makes up about half an inch. It varies considerably in colour, but is usually brownish-yellow, with dark spots above, and with a yellow streak enclosing the eye on each side of the face; the under surface is yellowish. The ears are very short, scarcely projecting beyond the fur; the eyes are small, black, and bead-like; the soles of the feet are hairy, and the claws of the fore feet much stronger than those on the hinder extremities. The Norwegian Lemmings live and breed among the peat mosses of the mountains. They are lively and active little creatures both by day and night, and feed upon the scanty vegetation of their Alpine home—grasses, lichens, the catkins of the dwarf birch, and roots. They are active even through the winter, when they make passages for themselves under the thick covering of snow which then veils the whole country, and thus are enabled to go in search of their ordinary food. They also make their way up to the surface, upon which they may occasionally be seen running, even in the depth of winter. They breed in their burrows and under stones, and must be very prolific, seeing that every predaceous animal in the country destroys and devours them. The Lemming is, in one sense, an exceedingly timid little creature, the slightest disturbance of its quietude, or even the passing over-head of a cloud, being sufficient to alarm it; but when attacked it displays the

most dauntless courage, standing on the defensive against both men and animals, and biting very sharply at anything that comes within its reach. From time to time, from some unexplained cause, the Lemmings start in vast swarms from their mountain fastnesses, and make their way in a straight line in some definite direction. Nothing seems to turn them from their course; they go straight on, over hill and dale, and, although said at other times to have an aversion to water, they now swim across any lakes or rivers that come in their way. In this operation many of them lose their lives, for they require smooth water for their navigation, and the least breeze ruffling the surface suffices to send hundreds of them to the bottom. In this way they gradually arrive at the cultivated regions, where they do so much damage to vegetation, that in olden times a special form of prayer and exorcism was in use against them. Their march is

LEMMING.

accompanied by great numbers of carnivorous beasts and birds of all sorts. Wolves, Foxes, and Wild Cats, and the smaller quadrupeds of the family Mustelidæ, Eagles, Hawks, and Owls, all prey upon them with avidity—even the Reindeer is said to stamp them to death; and the story of his eating them, long discredited, has been confirmed on good authority, while man, with his Dogs and Cats, is not behindhand in the work of destruction. Nevertheless, a great multitude survives all these dangers, and, strange to say, the termination of this painful migration is always the sea, into which the survivors of the march plunge, and, apparently, voluntarily commit suicide. Mr. Crotch, who has published several papers on the Lemming and its migrations, says that in Norway these animals always proceed from the central backbone of the country in an east or west direction, and that in either case the survivors of the march drown themselves, those that go westward in the Atlantic, those that go eastward in the Gulf of Bothnia. His notion is that the migration is in obedience to an inherited instinct acquired at a time when there was land where the sea now rolls; but there are many difficulties in the way of such a hypothesis.

Besides the Scandinavian Lemming above noticed, several other species occur in the northern parts of the world. Three species (*Myodes lagurus*, *obensis*, and *torquatus*) inhabit Siberia; the latter

two are found in North America, the last also in Greenland. In this species, which has been placed in a distinct genus under the name of *Cunicudus torquatus*, the third and fourth toes of the fore feet are much larger than the second and fifth (the thumb being rudimentary), and their claws become periodically enlarged to double their ordinary size by an enormous growth during winter of horny matter on the lower surface.

The transition from this to the next family is effected by two genera, which to such an extent combine the characters of the two as to have led different zoologists to place them sometimes in the one, sometimes in the other. Externally they have all the characters of the Mole-rats of the following family; in the characters of the skull and teeth they more resemble the Voles. The ZOKOR (*Siphneus aspalax*), which may be taken as an example of these forms, is an inhabitant of the Altai Mountains, has the eyes very small, the external ears reduced to mere rudiments, the body cylindrical, as in the true Mole-rats, and the fore-feet armed with very long and strong claws, of which that on the fifth toe is longer than the toe itself. This animal lives in subterranean runs something like those of the Mole, but of much greater extent, and in burrowing in the earth makes use of its strong incisors to cut through the roots it meets with, and when necessary to loosen the earth. The runs pass very near the surface, and are no doubt made for the purpose of feeding on the tender roots of grasses. A species of *Siphneus* is said to occur in North China. The other genus (*Ellobius*) includes two species; one (*E. lutescens*) from the country about the Sea of Aral; the other (*E. talpinus*) from south-eastern Russia and the west of Asia. The latter abounds in the Crimea. These animals form the sub-family Siphneinæ.

CHAPTER III.

MOLE RATS, POUCHED RATS, POUCHED MICE, JERBOAS, AND OCTODONTIDÆ.

SPALACIDÆ, OR MOLE RATS—Characteristics of the Family—Habits—Food—THE MOLE RAT—Distribution—Description—THE CHESTNUT MOLE RAT—THE NAKED MOLE RAT—THE STRAND MOLE RAT—Description—Habits—THE CAPE MOLE RAT—GEOMYIDÆ, OR POUCHED RATS—Characteristics of the Family—The Cheek-pouches—THE COMMON POCKET GOPHER—Distribution—Description—Burrowing—Runs—Subterranean Dwelling—THE NORTHERN POCKET GOPHER—HETEROMYINÆ, OR POUCHED MICE—Difficulties as to Position—Characteristics—PHILLIPS' POCKET MOUSE—Where Found—Description—THE YELLOW POCKET MOUSE—THE LEAST POCKET MOUSE—DIPODIDÆ, OR JERBOAS—Organisation for Jumping—Characteristics—Distribution—THE AMERICAN JUMPING MOUSE Description—Characters peculiar to Itself—Habits—THE TRUE JERBOAS—Characters—THE JERBOA—Distribution—Habits—Mode of Locomotion—THE ALACTAGA—THE CAPE JUMPING HARE—THE PORCUPINE-LIKE RODENTS—OCTODONTIDÆ—Characteristics—Sub-Family, CTENODACTYLINÆ—THE GUNDI—THE DEGU—Description—Habits—THE BROWN SCHIZODON—THE TUKOTUKO—THE CURURO—THE ROCK RAT—Sub-Family, ECHINOMYINÆ—THE COYPU—One of the Largest Rodents—Description—Burrows—Habits—Mother and Young—THE HUTIA CONGA—THE HUTIA CARABALI—THE GROUND RAT.

FAMILY VIII.—SPALACIDÆ (MOLE RATS).

ALTHOUGH the Zokor and its allies in the preceding family have to a certain extent prepared us for the peculiar characters presented by the Mole-rats, these are exhibited by the latter in a much more extreme form. They have a very large broad head, which is usually flattened above, and forms an appropriate anterior termination to a clumsy, cylindrical body, supported upon short stout limbs; their incisor teeth are large and broad, and are most formidably exposed in front of the mouth; their eyes are exceedingly small, hidden in the fur, and sometimes quite rudimentary; the external ears are reduced to the smallest possible size, or altogether wanting; and their tails are either so short as to be concealed within the hair of the hinder part of the body, or altogether wanting externally, although the skeleton still shows some caudal vertebræ. The molar teeth are rooted, and not tuberculate; their surface shows re-entering folds of enamel. The feet have five toes, but the thumb is generally very small, although furnished with a nail. The number of molars varies from three to six on each side in each jaw.

In their mode of life, as in their form and the condition of the organs of sight and hearing, these animals present a considerable resemblance to the Moles; but as their food is exclusively of a vegetable nature, the object of their burrowing is not exactly the same. They all inhabit the eastern hemisphere, and are generally met with in dry sandy plains, the soil of which lends itself readily to

mining operations. They seldom quit their burrows, and usually work in these only at night, when they make their way rapidly through the ground, and, like the Mole, can run either backwards or forwards in their subterranean galleries with equal facility. They feed chiefly on roots, and especially on the bulbs and tubers which so many plants possess in the dry districts which they frequent; but some of them also eat nuts, seeds, the young bark of trees, and herbage. None of them fall into a state of torpidity during the winter—indeed, only two species inhabit northern regions; but these, although active in the winter season, are said not to take the precaution to lay up a store of provisions.

SKULL OF MOLE-RAT.

Most zoologists distinguish two groups of Spalacidæ. In the SPALACINÆ, the representatives of which range from south-eastern Europe to further India and the south of China, and also occur in Africa in the countries of Abyssinia and Shoa, the palate between the molar teeth is broader than one of the sockets of the molars, and the angular portion of the lower jaw springs from the lower edge of the bony case of the incisor. To this group belongs the MOLE-RAT (*Spalax typhlus*), which inhabits Hungary and Galicia, and the south-east of Europe generally, and ranges eastwards into Asia as far as the Caucasus and Ekaterinoslav. It possesses only three molars on each side in each jaw, and has the eyes rudimentary and covered by the skin, so that the animal is quite blind; the upper incisors are placed perpendicularly; and the tail reduced to a sort of wart. The toes, especially those of the fore-feet, are furnished with very powerful claws, which are vigorously employed by the animal in the digging operations above described. The general covering of the body is a soft fur of a yellowish-brown colour, tinged with ashy-grey; the head lighter, but becoming brownish behind; and the lower surface ashy-grey, with some white streaks and spots. The muzzle, chin, and feet are whitish, and along each side of the face there runs a sort of ridge of stiff bristle-like hairs. This species is particularly abundant in the Ukraine and the country about the Volga and the Don.

MOLE-RAT.

The genus *Rhizomys*, of which there are an East Indian and two African species known, has the eyes uncovered, though very small, short naked ears, and a short partially hairy tail. The upper incisors are arched forward. The CHESTNUT MOLE-RAT (*Rhizomys badius*) lives in Northern India, Siam, and Arracan; and, according to Mr. Finlayson, the food of a specimen in confinement consisted of unhusked rice and other grain, but he showed himself fond of yams and pumpkins. The NAKED MOLE-RAT (*Heterocephalus glaber*), which has no external ears and a short tail, has the body almost entirely naked. It is a native of Shoa.

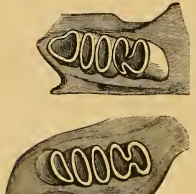
The other section of the Mole rat family, the BATHYERGINÆ, is entirely confined to Africa, and, indeed, almost exclusively to the southern extremity of that continent, only a single species being

found elsewhere—at Mozambique. They show a resemblance to the Hystricine Rodents in the structure of the lower jaw, the angular portion of which springs from the side of the bony case of the lower incisor; and the palate between the molars is narrower than in the Spalacinæ. The best known of the six species inhabiting the Cape of Good Hope is the STRAND MOLE-RAT (*Bathyergus maritimus*), which is nearly as large as a small Rabbit, its length being about ten inches, with a tail two inches in length. In general form it resembles the species last described; it has small but uncovered eyes, a broad nose, no external ears; very long, compressed, and powerful claws on all the toes, except the thumb of the fore-feet, which has a crooked nail; four molars on each side, and long white incisors, of which the upper ones are strongly grooved in front. The colour of the fur is greyish-white, with a yellowish tint on the upper surface. The tail has a sort of radiating tuft of hairs at the end. The Strand Mole-rat lives entirely in sandy localities near the sea-shore, and especially in the sand-hills or dunes which fringe the coast of the Cape of Good Hope in some parts. Here it burrows freely in all directions, its galleries generally radiating from several central points, and joining in various places. It avoids the light as much as possible, and if by chance it is exposed on the surface it is exceedingly helpless. Very little is known of the habits of this species, which probably feeds chiefly on roots like the other members of the family. It is regarded as mischievous, as it undermines the ground so much as to make it unsafe to ride over. The colonists, therefore, often destroy it by various means. The enamel folds of the teeth become effaced with use.

The *Georychi*, five species of which inhabit Cape Colony, resemble the preceding species, but are smaller and weaker. The claws of the fore-feet are shorter and weaker, and the upper incisors, which are long and arched forward, are not grooved. The best-known species is the so-called CAPE MOLE-RAT (*Georychus capensis*). In the Mozambique species (*Heliophobius argenteo-cinereus*) there are six molars on each side above and below, and the second toe of the hind feet is the longest. In most other characters it resembles *Georychus*.

FAMILY IX.—GEOMYIDÆ, OR POUCHED RATS.

The Pouched Rats, or Pocket Gophers, and the Pouched Mice of North America, constitute a family distinguished from all the preceding forms by the presence of a pair of great cheek-pouches, opening *outside* and not inside the mouth (*see* figure). These cheek-pouches are hairy inside throughout. The angular portion of the lower jaw is strongly twisted, the molars are four in number on each side in each jaw, and the squamosal bone is very large. In external characters the animals of this family present considerable diversity, which has led to their being divided into two well-marked sub-families, the distinctive peculiarities of which are of such importance that Dr. Coues has raised them to the rank of distinct families. The GEOMYINÆ, or Pouched Rats, are more or less Rat-like animals, in which the feet are five-toed, and all the toes furnished with claws, those of the fore feet being very strongly developed; and the tail is short. Certain other characters are presented by the skull. The outline of this part, including the zygomatic arches, is almost quadrangular; the infra-orbital opening is far in front of the jugal process; the malar bone extends forward to the lachrymal.



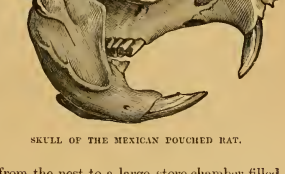
MOLAR TEETH OF THE MEXICAN POUCHED RAT.

UNDER SURFACE OF THE HEAD OF HETEROMYS.

Of the animals thus characterised, the Continent of North America possesses, according to Dr. Coues, seven species, and they are met with from Hudson's Bay and the Columbia River in the north, as far south as Mexico. The best-known species, the COMMON POCKET GOPHER (*Geomys*

bursarius), inhabits the whole valley of the Mississippi, and extends northwards into Canada. It reaches the foot of the Rocky Mountains in Colorado, but is not known to occur west of that range. It is also found in Texas. This Pouched Rat, like the rest of its genus, has the incisors broad and the upper ones deeply grooved; but in addition to the ordinary deep groove it has a fine line close to the inner margin of each of these teeth. Its form is stout and clumsy, but its coat is beautifully soft and velvety, like that of the Mole, but of a dull reddish-brown colour, with the feet and tail white. The average length of an adult specimen is from seven to eight inches, and the tail is two or three inches long. This organ is clothed with hair nearly to the tip.

Like the Mole, this animal lives in burrows, which it makes in all directions in the ground, throwing out as it proceeds heaps of earth, which exactly resemble ordinary mole-hills. To enable it to perform these labours the claws of the fore feet are exceedingly powerful; and to adapt it the better to its subterranean existence, the eyes are very small, and the external ears are wanting. Its digging operations have generally the same object as those of the Mole—namely, the search for food. The tunnel is carried along not far from the surface of the ground, and the roots of any plants that lie in its course are bitten off and devoured by the little miner. Besides the runs, the Pouched Rat digs himself a convenient dwelling in the shape of a chamber hollowed out under the roots of a tree, access to which is gained by a somewhat spiral descending passage. This chamber, which is usually at a depth of four or five feet, is comfortably lined with soft grass, and the nest in which the female brings forth her young is a cavity of the same kind, but surrounded by circular passages, from which, like that of the Mole, other passages branch off. One of these, according to Gesner, leads from the nest to a large store-chamber filled with nuts, seeds, and roots, among which the potato was found to play an important part. These provisions are carried to the store-house in the great cheek-pouches, which the animal is said to fill by the aid of its tongue, and to empty with the fore paws. This Pouched Rat does much damage in cultivated ground by attacking the roots of both plants and trees, sometimes destroying a great number of the latter in a few days. The female produces from five to seven young at the end of March or the beginning of April. The other species of *Geomys* closely resemble this in their habits.



SKULL OF THE MEXICAN POUCHED RAT.

Of the second genus belonging to this sub-family (*Thomomys*) Dr. Coues admits only two species, one of which, however, occurs under three named forms. They may be distinguished from the species of *Geomys* by their having the upper incisors plain, without grooves.

The NORTHERN POCKET GOPHER (*Thomomys talpoides*), with its sub-species, ranges over nearly the whole of North America from the Hudson's Bay Territory to California and New Mexico. The three forms are for the most part in accordance with geographical distribution. A small species (*Thomomys clusius*) has been obtained in the Rocky Mountains.

The HETEROMYINÆ (forming the family Saccomyidæ of Dr. Coues, although he does not accept the genus *Saccomys*) are more slender and delicate in form than the Geomyinæ, and have the hind limbs and tail elongated, the former, indeed, being converted into leaping organs like those of the Jerboas and Kangaroos. The eyes and ears are larger, and the animals are in every respect adapted to life in the open, while the Geomyinæ, on the contrary, are subterranean in their habits. The hair in the present family is coarse and harsh, sometimes even spiny. In skeletal characters we find a similar alteration. The incisors are narrow; the skull is delicate, with its angles rounded off, and the mastoid bones form a considerable part of the roof of the cranial cavity; the zygomatic arches are slender; and, the lower root of the maxillary process being undeveloped, the infra-orbital opening is not defined. As in the Jerboas, the cervical vertebræ are sometimes anchylosed. Like the Geomyinæ, these animals are confined to America, and chiefly limited to the Southern United States and Central America, although some of the species occur as far north as the Columbia

River and Hudson's Bay, and one is found in Trinidad. By American writers they are called "Pocket Mice."

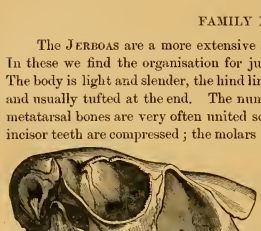
Phillips's Pocket Mouse, also known as the Kangaroo Rat (*Dipodomys Phillipsii*), is one of the best known species of this group. It is an elegantly formed little creature, about four inches long, with a slender tail nearly six inches in length. Its colour above is mouse-brown, white beneath; the sides of the body have some white streaks, especially one from the ear towards the shoulder, and one on the thigh running towards the root of the tail; the tip of the tail is also white. This is a Californian species, but extends throughout the Pacific region of the United States. It is represented in the Rocky Mountains by a rather larger and stouter form, with smaller ears and a shorter tail (*Dipodomys Ordii*), which is generally regarded as distinct, but is placed by Dr. Coues as a subspecies. The habits of the species are comparatively little known, but they appear to live in the most desert places they can find, the barren spots on which the only plants that seem to flourish are the great mis-shapen cactuses. They dwell in holes under rocks and stones, from which they emerge at sunset, and hop about gaily after the fashion of little Kangaroos. The places in which these Pocket Mice are found are so bare of vegetation and destitute of water, that it is difficult to imagine how they contrive to exist. In all probability they pick up a scanty living in the shape of roots and grasses, especially seeds, carrying a supply for the day into their holes in their great cheek-pouches.

The Yellow Pocket Mouse and the Least Pocket Mouse (*Cricetodipus flavus* and *parvus*) are very minute creatures, only about two inches long in the head and body. The tail is longer than the head and body in the latter, shorter in the former species, and the colour of the fur in both is a pale buff. These species are found in the Rocky Mountains and the region west of that range to the Pacific, the latter being inhabited by the second of the above species. Several species of the genus *Heteromys* inhabit Central America, and one is found in the island of Trinidad. Nothing appears to be known of their habits.

From these we pass as by a natural transition to

FAMILY X.—DIPODIDÆ (THE JERBOAS).

The Jerboas are a more extensive and much more widely distributed family of hopping Rodents. In these we find the organisation for jumping brought to greater perfection than in any other group. The body is light and slender, the hind limbs much elongated, the fore limbs very small, and the tail long and usually tufted at the end. The number of toes on the hind feet varies from three to five, and the metatarsal bones are very often united so as to form what is called a "cannon bone" in the Horse. The incisor teeth are compressed; the molars sometimes four, but usually three in each series, rooted or rootless, not tuberculate; the infra-orbital opening is rounded and very large, and the zygomatic arch slender. The great home of these animals is the vast steppe region which stretches from South-eastern Europe across the greater part of Central Asia, but they extend southwards round the eastern extremity of the Mediterranean, through Syria and Arabia to Egypt and Africa, over a great part of which they are found, and eastward to India, Afghanistan, and Ceylon. A single species occurs at the Cape of Good Hope; and another is found in North America. We may commence by noticing this last species, as it not only makes the nearest approach to those of preceding families, especially the Muridæ, but differs from the rest of the Jerboas in characters of such importance, that Dr. Coues maintains its right to form a separate family (*Zapodidæ*).



SKULL OF THE CAPE JUMPING HARE.

The American Jumping Mouse (*Zapus* hudsonius*) has a wide range, extending across

* Dr. Coues has proposed this generic name for the American Jumping Mouse, as the names *Jaculus* and *Meriones*, given to the genus by various authors, had been previously used for other groups.

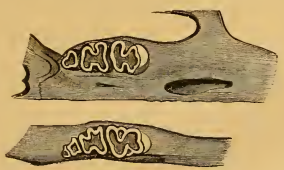
the continent of North America from sea to sea, and from Labrador, Hudson's Bay, and the Great Slave Lake in the north, to Virginia and the elevated portions of Arizona and New Mexico in the south. It is an elegant little mouse-like creature, rather more than three inches long, and furnished with a cylindrical tail, which exceeds the head and body in length by about two inches. Its hind limbs are not quite so disproportionately developed as in the other members of the family. Its fur in summer is of a brown colour above, becoming yellowish on the sides and white below; in the winter the brown tint covers the whole surface. The ears, which are not very large, are black, with a light-coloured rim; the hind feet are greyish, and the fore feet whitish on the upper surface; and the tail, which tapers to an exceedingly fine point, where there is a fine pencil of hairs, is ringed and nearly naked.

The characters in which this animal differs from its nearest relatives are as follows:—In the upper jaw there are four rooted molars on each side, the first being very small, the second the largest, and the rest gradually diminishing in size; the fore feet have the thumbs rudimentary, and the hind feet

AMERICAN JUMPING MOUSE.

have five toes, all of which touch the ground; the metatarsal bones are separate; and the soles of the feet naked, with granules and small horny shields.

The American Jumping Mouse is found in meadows in the neighbourhood of woods and copses. It is nocturnal in its activity, sleeping during the day in its burrow, which is usually about two feet deep, and coming forth at night. It is sociable in its habits, and excessively active, covering from three to five feet of ground at each leap, so that it is a matter of no little difficulty to capture a specimen in the open. In the woods it is worse, as the little creature will bound over bushes, and get out of sight in a moment. Its food consists of seeds of various kinds, and it is exceedingly fond of beech-mast. For protection from the cold of winter the Jumping Mouse makes a little hollow clay ball, within which it coils itself up, and goes comfortably to sleep. The nest is made about six inches under the surface of the ground, and is composed of fine grass, sometimes mixed with feathers, wool, and hair; and in this the female produces from two to four young, probably several times in the course of the summer, as the nests and young are to be found from May to August.

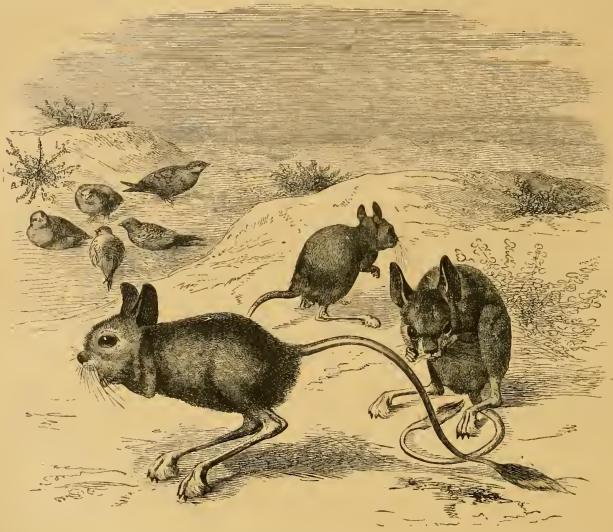


MOLAR TEETH OF THE JERBOA.

If we regard the American Jumping Mouse as constituting a peculiar section of the family, ZAPODINÆ, a second group, DIPODINÆ, is formed by the TRUE JERBOAS, which make up the greater

part of the family. These either possess only three molars, or a very small additional tooth exists in front of each series in the upper jaw. The molars are rooted, and diminish in size backwards in each series. The cervical vertebræ are anchylosed; the fore feet have the thumbs rudimentary, but sometimes furnished with a small nail; the hind feet have only three toes fully developed, and the metatarsals are united into a single bone of great length; the soles are furnished with elastic balls; and the tail is very long, well-clothed with hair, and tufted at the end.

Of these pretty little creatures, which are in some respects singularly bird-like, about twenty species have been recorded, and these occupy the whole of the Old World area of the family, except



JERBOA.

South Africa. The Jerboa (*Dipus ægyptius*) may serve as an example of this section of the family. This is a most lively and active little creature, which inhabits the deserts of north-eastern Africa as far south as Nubia, and extends its range into Arabia and south-western Asia. On these arid plains, so scantily clothed with a few grasses and dry shrubs that it is difficult to conceive how any animal can find a living on them, the Jerboa lives, often in numerous societies, and in company with the few birds and lizards which enliven the wilderness. These animals dwell in subterranean abodes consisting of many branched galleries, which they dig out in the hard soil not far from the surface. The Arabs assert that these habitations are produced by the joint labour of the whole society. They retreat into their burrows at the least alarm. The females are said to produce from two to four young at a birth in a nest made in the deeper part of the burrow, and lined with hair pulled from the under surface of her own body. When going along quietly, the Jerboa walks and runs by alternate steps of the hind feet, but when there is occasion for rapid motion it springs from both feet at the same time, covering so much ground at each leap, and touching the ground so momentarily between them,

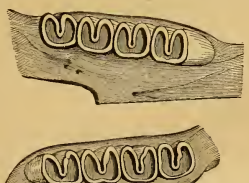
that its motion is more like that of a bird skimming close to the surface of the ground than that of a four-footed beast.

The Jerboa is about six inches long, with a tail about eight inches in length exclusive of the tuft with which its tip is adorned. Its upper surface is of a greyish sand-colour, like that of many other desert animals; the lower surface is white; and the tail pale-yellowish above and white beneath, with the tuft white, with an arrow-shaped black mark on its upper surface.

Several other species of Jerboas are known, some from the deserts of North Africa, others from the steppes of Central Asia. The latter region harbours some forms, which differ from the preceding, among other characters, by having five toes in the hind feet, whereas the true Jerboas have only three, but of the five toes only three are sufficiently developed to take part in the animal's progression. The best known of them is the ALACTAGA (*Alactaga jaculus*), a rather larger species than the Jerboa,

ALACTAGA.

and with a still longer tail, reddish-yellow with a greyish tinge above, white beneath and on the hind legs. Its range extends from the Crimea and the steppes of the Don across Central Asia to the borders of China. It walks upon all-fours, and when advancing quickly springs along after the fashion of the Jerboa. Its food consists of all sorts of vegetable substances, but it is especially fond of the bulbs of plants, and does not refuse occasionally to eat insects, or even the eggs and young of the birds which inhabit the steppes with it. The Alactagas live in very complicated burrows, with many passages and branches, and they are said always to make one passage from the central chamber of their residence, which terminates close to the surface of the earth at some distance, but is only opened in case of danger, when the inhabitants escape through it, the position of its intended aperture being previously unrecognisable. In cold weather they sleep in their nests. The female produces from five or six to eight young, in a nest lined with her own hair. Species of *Alactaga* occur not only in Central Asia, but also in Arabia and North Africa.



MOLAR TEETH OF THE JUMPING HARE.

South Africa produces one species, the CAPE JUMPING HARE (*Pedetes caffer*), which constitutes a distinct sub-family, PEDETINÆ, having four rootless molars on each side in each jaw, the metatarsal bones

CAPE JUMPING HARE.

separate, the tail bushy, and the hind feet furnished with four toes having broad, hoof-like nails. This is a much larger animal than any of the preceding, being about the size of the common Hare, which it also resembles in its colours. The Jumping Hare inhabits a considerable portion of South Africa, extending on the west coast at least as far as Angola. It is abundant at the Cape of Good Hope, both in the mountains and in the plains. Great numbers of the animals often live together, and their burrows, which, like those of other Dipodidæ, are inhabited by numerous individuals as a common residence, consist of many-branched galleries made at no great depth from the surface, but leading into a more deeply-seated habitation. They generally go about slowly upon all-fours, but can advance with extraordinary rapidity by Kangaroo-like springs, in each of which, when pressed, they will cover a space of twenty or thirty feet. Their food consists of roots, seeds, and herbage. The female produces three or four young at a birth.

SECTION III.—PORCUPINE-LIKE RODENTS (*HYSTRICOMORPHA*).

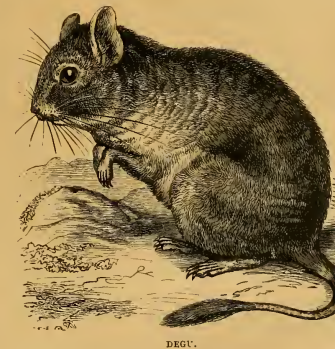
FAMILY XI.—OCTODONTIDÆ.

This first family of the Porcupine alliance consists of a number of rat-like animals, nearly all of which are inhabitants of South America, three species only being peculiar to the large West Indian Islands, whilst, singularly enough, four more are known from different parts of the African continent. Except in one of these last, all the members of the family have four molars on each side in each jaw, and the crowns of these teeth show internal and external folds of enamel. The malar portion of the zygomatic arch has an angular process at its lower margin.

The hind limbs are not disproportionately developed, and both they and the fore feet are nearly always furnished with five toes, armed with curved claws; and the clavicles are perfect. The ears are generally short and sparingly hairy, and the tail, which is of various lengths, is either clad with short hairs, or naked and scaly.

We may begin with two African species of this generally American family, which have the two inner claws of the hind feet furnished with comb-like fringes of horny bristles, whence the name of *Ctenodactylus* has been applied to the best known species. These two species, which exhibit strong affinities to the Jerboas, form the sub-family CTENODACTYLINÆ. The GUNDI (*Ctenodactylus Massoni*) has only three molars on each side in each jaw, and only four toes upon each foot. It is an animal about the size of the Water Rat, but with a mere stump of a tail, very small ears, very long whiskers, and the hind limbs rather longer than their fellows. It lives in North Africa, chiefly on the borders of the Sahara, where it takes up its abode in the rocky hills, and descends therefrom to the cultivated grounds to feast upon the growing corn. It is diurnal in its habits, but exceedingly shy and watchful, making off to its fastnesses at the least appearance of danger. *Pectinator Spekei*, a species named after its discoverer, the celebrated African traveller, is nearly related to the preceding, but has a small additional molar in each series. The tail is of moderate length, and bushy, and the ears have a small antitragus. It inhabits the Somali land in the interior of North-eastern Africa.

The DEGU (*Octodon Cumingii*), a very abundant species in Chili, which also extends into Peru, may be taken as a typical example of the whole family, and also of its typical sub-family OCTODONTINÆ, in which the molars are simply indented on each side. The fur is soft, and the tail is short. The Degu is a rat-like animal, rather smaller than the Water Vole, the head and body measuring from seven and a half to eight inches in length, and the tail, exclusive of its terminal tuft, rather more than half that length. The general colour of the animal is brownish-yellow, pencilled with black on the back; the lower surface is yellowish, the feet white, and the tail dusky above, whitish beneath, with the tufted tip dusky or blackish. In the central parts of Chili, according to various travellers, the Degu is exceedingly abundant, living in large societies about hedges and thickets, and running about boldly, even on the high roads. The animals make their burrows in the hedge-banks and similar places, and when alarmed rush into them with their tails elevated, very much after the manner of Rabbits. As the burrows communicate freely with each other, the Degus can easily escape pursuit, going in at one opening and coming out at another at some considerable distance. They sometimes climb up into the bushes among which they live. Their ordinary food consists of the herbage which grows about their dwelling-places, but they also invade gardens and fields, where they may do considerable damage. In the winter they will feed upon the tender bark of certain trees, but they are said by some authors to lay up a store of food against this season. They do not become torpid. The female is believed to produce two broods in the year, each consisting of from four to six young.

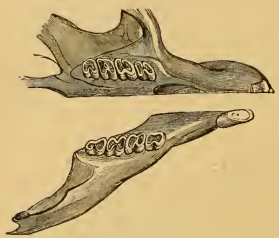


DEGU.

Two other species of *Octodon* are known from Chili and Bolivia, which region is also inhabited by two species of *Habrocoma*, a genus distinguished by the large size of the ears, and the extreme softness of the fur. In these animals the molar teeth differ in the two jaws, the upper ones being as simple as in the preceding species, while the lower ones show a complication of the enamel folds like what we shall meet with in the third sub-family.

The Brown Schizodon (*Schizodon fuscus*), which inhabits certain elevated spots in the southern part of the Andes (75° S. lat.), has the enamel folds of the molar teeth meeting in the middle. It is about the size of the common Rat (seven and a half to nine inches long), and has a shortish tail clothed throughout with short hairs. Its fur is dark brown above, dirty yellowish beneath. This animal inhabits grassy places near mountain streams, where the ground is sometimes so undermined by its burrows as to render travelling on horseback very uncomfortable. It is a nocturnal animal, and passes most of its life underground. The valleys it inhabits are covered with snow for at least four months in the year.

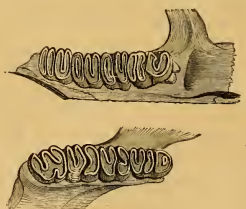
In the Tukotuko (*Ctenomys brasiliensis*) and its congeners, about four of which are known from different parts of South America, one of them extending as far south as the Strait of Magellan, the eyes and ears are very small, and the animal seems to be still more specially adapted to a subterranean mode of life. In these animals the claws are longer than the toes, and those of the hind feet are fringed with a sort of comb formed of bristles. The incisor teeth are very broad. The Tukotuko is about the size of a large Rat, namely, from eight and a half to nine and a half inches long, with the tail from two and a half to three and a half inches. Its name is in imitation of the sound which it constantly emits—a sound which rather surprises a stranger when he first hears it, seeing that the animal uttering it is concealed underground. In many places, as in the Argentine Republic, this animal is exceedingly numerous, living generally in sandy soil, but sometimes in damp situations. It makes long burrows not far from the surface, and thus in some places completely undermines the ground. In making these galleries the Tukotuko is engaged in the search for its food, which consists chiefly of the roots of plants. According to Azara, it lays up stores of food in its burrows. Its activity is nocturnal.



DENTITION OF THE ROCK RAT.

The Cururo (*Spalacopus Pöppigii*) has the ears quite rudimentary, and is also organised for a subterranean existence. This and another species inhabit Chili, where they make extensive burrows in the ground, and feed upon the bulbous and tuberous roots of various plants, large stores of which they collect in their subterranean abodes. These magazines are sought out by the poorer people, and their contents used as food.

The Rock Rat (*Petromys typicus*), although most nearly allied to the preceding species, lives on the opposite side of the Atlantic in the rocky hills of South Africa, especially towards the mouth of the Orange River. It differs from the preceding forms in the harshness of its fur, in which it resembles another sub-family of Octodontidæ, in the shortness of its thumbs, which are furnished with a small nail, and in its rather bushy tail. The molars are semi-rooted, with the enamel folds nearly meeting in the middle. The whiskers are of great length, and entirely black. The general colour is reddish-brown, with the head and fore parts greyish, the throat whitish, and the belly pale yellow. The tail is of the colour of the body at the root, with the remainder black. The length of the animal is about seven and a half inches, of the tail from five to five and a half inches. It feeds upon various vegetable substances, and appears to be very fond of the flowers of syngenesious plants, especially a species of groundsel, which it eagerly devours. It forms its retreat among loose stones, or in crevices of the rocks.



TEETH OF THE SPINY RAT.

While the Octodontinæ may be regarded as specially characteristic of the region of the Andes, the other great group of this family is almost exclusively confined to the country east of that great chain, and to some of the West Indian islands. Curiously enough this sub-family also has a single

representative in Africa. Its members are distinguished at once by the complicated enamel folds of their molar teeth in both jaws, by these teeth being generally rooted, and by the texture of the fur, which is harsh and frequently mixed with fine spines. Hence the name of *Echinomys* (Spiny, or rather Hedgehog, Rat), applied to the typical genus, from which the sub-family is named ECHINOMYIN.E. The tail in these animals is usually long.

The Rodents belonging to this sub-family are generally of considerable size, as large as Rats, or larger, stoutly built, with the hinder part of the body larger than the fore-quarters, with limbs of moderate length, the hinder larger than the anterior, the former furnished with five toes, the latter with four complete digits and a rudimentary thumb, and the toes armed with strong curved claws. The tail is scaly, with scattered hairs. In their habits these animals appear to be strictly vegetable-feeders, but in other respects they present some variety. The majority live in and upon the ground; but one or two are arboreal, and one aquatic, in their mode of life.

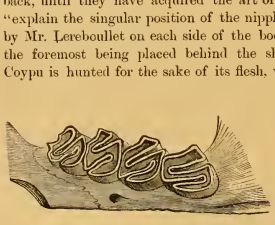
The last species alluded to is the well-known COYPU (*Myopotamus Coypus*), one of the largest of Rodents, which occurs in nearly all parts of South America and on both sides of the Andes, from the tropic of Capricorn to about 15° N. lat. It is usually about twenty inches long, but often attains still greater dimensions. The tail, which is about two-thirds the length of the head and body, is scaly, with hairs about as thickly scattered as in the common Rat. The ears are of moderate size; the incisor teeth very large and powerful; the molars, the hindmost of which are the largest, have two internal and two external enamel-folds in the upper, and three internal folds and one external in the lower, jaw; the hind feet are webbed. The general colour of the upper surface is brown, produced by dusky and brownish-yellow pencilling; the sides and under parts are brownish-yellow, and the front of the muzzle and the chin white.

The Coypus live upon the shores of the rivers and lakes of South America, generally, according to Rengger, in pairs, each pair digging for themselves a burrow in the bank, which extends to a depth of three or four feet, and widens out into a cavity eighteen inches or two feet in diameter. Here they pass the night, and take refuge when necessary during the day. They select for their dwelling-places the stiller parts of the water, where the aquatic plants on which they chiefly feed grow freely. They are said to swim well, but not to be expert in diving. On land they are slow and awkward in their movements. They feed chiefly on the roots of plants, but in the Chonos Archipelago, where the Coypus frequent the sea and make their burrows at some little distance from the beach, they are said

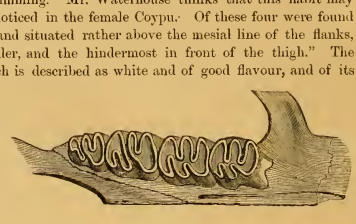
COYPU.

HUTIA CONGA.

occasionally to eat shell-fish. The female produces from four to five young once in the year. The little animals very early accompany their mother into the water, when she swims with them on her back, until they have acquired the art of swimming. Mr. Waterhouse thinks that this habit may "explain the singular position of the nipples noticed in the female Coypu. Of these four were found by Mr. Lereboullet on each side of the body, and situated rather above the mesial line of the flanks, the foremost being placed behind the shoulder, and the hindermost in front of the thigh." The Coypu is hunted for the sake of its flesh, which is described as white and of good flavour, and of its



TEETH OF PLAGIODON.

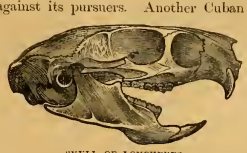


MOLAR TEETH OF LONCHERES.

skin, which is well known in the fur trade under the name of "Nutria," signifying Otter. Great quantities of these skins are annually exported from Buenos Ayres. It is said to be a courageous animal, fighting bravely with the dogs engaged in chasing it.

The HUTIA CONGA (*Capromys pilorides*) is another large Rodent, measuring from twenty to twenty-two inches in length, with a stout rat-like tail about half as long as the head and body. It is an inhabitant of Cuba. The incisors are considerably smaller and weaker than in the Coypu; the upper molars have one internal and two external folds; the lower ones are similar but reversed. The fur, which is long, is very harsh, and consists of a mixture of black and yellow hairs, becoming rusty on the hinder part of the body. The belly is rusty yellow. This animal lives in the dense

forests of Cuba, where it resides either upon the trees or in the thick underwood. It is a nocturnal or crepuscular animal, and is tolerably active when going about on the branches of trees, but is less at home on the ground. Its food consists of fruits, leaves, and the bark of trees, but, according to M. Ramon de la Sagra, it does not disdain animal food, and is especially fond of a species of Lizard belonging to the genus *Anolis*. On the other hand, the negroes are very partial to the flesh of the Hutia, and they capture the animal either by snaring it on the branches of trees, or by sending Dogs after it Like the Coypu, it is said to fight courageously against its pursuers. Another Cuban species, the HUTIA CARABALI (*C. prehensilis*), has a slightly longer tail, which is prehensile at the tip. It is described as keeping chiefly to the highest branches of the trees. In St. Domingo there is an allied form, *Plagiodon odium*, in which the enamel folds of the molars are singularly complex (*see* figure on p. 132). This animal frequents the neighbourhood of human habitations, and approaches them at night in search of its food, which consists of fruit and roots. In most of the other members of this sub-family, which appear to be terrestrial in their habits, the intermixture of spines with the fur of the back is a striking character. In the genus *Echinomys* itself, and in *Loncheres*, which together include about a dozen species found chiefly in Guiana and Brazil, the spines frequently form the principal outer covering of the back. Side by side with these hedgehog-like species, however, others occur in which the fur is soft.



SKULL OF LONCHERES.

The GROUND RAT (*Aulacodus Swinderianus*), of Western and Southern Africa, is remarkable as being the sole representative of this group outside the South American province. It has very broad incisors, and those of the upper jaw exhibit three deep grooves; the molars show the same arrangement of folds as in *Capromys;* the fur is harsh and bristly, and of a general brown tint; and the tail is of moderate length, sparingly haired, dusky above, and whitish below. The fore feet have the thumb rudimentary and the outer toe very short; and the hind feet have only four toes, of which the outer one is rudimentary. This curious animal, which is nearly two feet long, is known to be an inhabitant of Sierra Leone and the Gambia, and also of South Africa (Port Natal); in all probability it occurs at many intermediate localities. In Sierra Leone it is known as the Ground Rat, or Ground Pig, and is said to feed upon ground nuts, and cassada and other roots in search of which it digs into the ground, where it also forms large burrows for its residence.

CHAPTER IV.

PORCUPINES—CHINCHILLAS—AGOUTIS—CAVIES—HARES AND RABBITS—PIKAS.

HYSTRICIDÆ, THE PORCUPINES—Conversion of Hairs into Spines—Skull—Dentition—Tail—Sub-families—The True Porcupines—The Tree Porcupines—THE COMMON PORCUPINE—Distribution—Description—The Crest of Bristles—Nature of the Spines—Habits—Young—Flesh—On the Defensive—Other Species—Species of Tree Porcupines—THE COUENDOU—THE COUIY—Description—Habits—THE URSON, OR CANADA PORCUPINE—Description—Habits—Food—CHINCHILLIDÆ, THE CHINCHILLAS—Characteristics—THE VISCACHA—Description—Life on the Pampas—Their Burrows—Habits—The Chinchillas of the Andes—THE CHINCHILLA—THE SHORT-TAILED CHINCHILLA—CUVIER'S CHINCHILLA—THE PALE-FOOTED CHINCHILLA—DASYPROCTIDÆ, THE AGOUTIS—Characters—THE AGOUTI—Distribution—Appearance—Habits—AZARA'S AGOUTI—THE ACOUCHY—THE PACA—Appearance—Distribution—Habits—DINOMYIDÆ—Founded for a Single Species—Description—Rarity—CAVIIDÆ, THE CAVIES—Characteristics—THE RESTLESS CAVY—Appearance—Habits—The Guinea-Pig Controversy—THE BOLIVIAN CAVY—THE ROCK CAVY—THE SOUTHERN CAVY—THE PATAGONIAN CAVY, OR MARA—Peculiar Features—Its Burrows—Mode of Running—THE CAPYBARA—Its Teeth—Where Found—Habits—THE DOUBLE-TOOTHED RODENTS—Characteristics—LEPORIDÆ, THE HARES AND RABBITS—Structural Peculiarities—Distribution—Disposition—THE COMMON HARE—Hind Legs—Speed—Its "Doubles"—Other Artifices—Its "Form"—Habits—Food—Pet Hares—THE RABBIT—Distribution—Habits—Domesticated—THE MOUNTAIN HARE—LAGOMYIDÆ, THE PIKAS—Characteristics—Distribution—THE ALPINE PIKA—THE ROCKY MOUNTAIN PIKA.

FAMILY XII.—HYSTRICIDÆ (PORCUPINES).

THIS second family of the section Hystricomorpha exhibits the conversion of the hairs into spines in perfection, the whole upper part of the body being in several instances completely

covered with long, hollow, pointed quills, whilst in all cases great numbers of spines and stiff bristles are mixed with the hair.

SKULL OF THE PORCUPINE.

The form of the skull in these animals is distinctive. It is ovate, the cranial portion being more or less inflated by air-cavities in the bones, and the facial portion short, but the occipital or hinder surface is usually nearly perpendicular; the malar portion of the zygoma has no angular process as in the preceding family; the molar teeth are four in number on each side in each jaw; and the limbs are about equal in development. The incisor teeth are large and powerful. With regard to the development of the tail there are considerable differences, some species having that organ quite short, while in others it is of moderate length, or long and sometimes prehensile.

The Porcupines fall readily into two distinct groups (subfamilies) characterised by structure, habits, and geographical distribution. In the strictly terrestrial species, or True Porcupines (HYSTRICINÆ), which inhabit the warmer parts of the eastern hemisphere, the skull is rather more elongated than in the others; the front margin of the orbit is over the third molar; the molars are

COMMON PORCUPINE.

rootless when young, but become closed after a time, and the clavicles are imperfect. The upper lip is furrowed; the tail, which may be either long or short, is never prehensile; the soles of the feet are smooth; and the female has six teats.

The arboreal species (SPHINGURINÆ), which are all American, have the skull peculiarly short, the front margin of the orbit over the first molar, the molars always rooted, and the clavicles perfect. The upper lip is not furrowed; the tail is moderate or long, and generally prehensile; the soles of the feet are covered with wart-like tubercles; and the female has only four teats.

The COMMON PORCUPINE (*Hystrix cristata*) may serve as a characteristic and well-known example of the first of these two groups. It is an inhabitant of the Mediterranean region, occurring in most parts of North Africa, and extending as far southwards as the Gambia and Soudan; in Southern Europe it is abundant in Italy, Sicily, and Greece. It measures about twenty-seven or twenty-eight inches in length to the root of the tail, which is about four inches long. The head, shoulders, limbs, and under parts are clothed with short spines intermixed with hairs usually of a dusky or brownish-

black hue; the neck is marked with a whitish collar; from the back of the head and neck there rises a great crest of long bristles, many of them fifteen or sixteen inches in length, which can be elevated and depressed at the pleasure of the animal, are gently curved backwards, and are either dusky with the extremities white, or whitish throughout; the hinder portion of the body is entirely covered by a great number of long, sharp spines, ringed with black and white, but always having the extremities white. These spines vary considerably in size, some of them being very long (fifteen or sixteen inches), comparatively slender and flexible; others shorter (from six to twelve inches), but much stouter. They are all hollow, or filled only with a sort of spongy tissue, but from their structure are exceedingly resistant, and when the animal erects them, which he is able to do by contracting the muscles of the skin in which their roots are imbedded, they constitute a most formidable armature. They appear to be but loosely attached to the skin, and readily fall out, a circumstance which no doubt gave rise to the belief prevalent among the ancients (and many moderns) that the Porcupine was able to shoot his spines at an approaching enemy, or even to project them behind him at a pursuer when he was rushing away in search of a place of safety. The tail of the animal bears at its tip about twenty spines of very curious construction; they are about two inches long, hollow, open, and cut off square at the end, and about a quarter of an inch in diameter for the greater part of their length, but they are inserted into the skin by the extremity of a thin stalk half an inch long.

The Porcupine lives in holes among the rocks, or in a burrow, which he makes for himself in ordinary ground. In this retreat he passes the day in sleep, coming forth in the evening in search of food, which consists of herbage of various kinds, fruits, roots, and the bark and leaves of trees and bushes. He is slow in his movements, and does not even display much activity in burrowing. His habits are solitary except during the pairing season; and during the winter he passes most of his time in his habitation, without, however, falling into a torpid state. The pairing takes place early in the year, but varies in this respect according to the climate of the locality; and in the spring or early summer the female produces from two to four young, in a nest carefully lined with leaves, grasses, roots, and other vegetable substances. The young Porcupines are born with their eyes open, and their bodies are covered with short, soft spines, which are pressed closely to the body. These speedily harden and grow longer, and the young do not appear to remain very long with their mother. The flesh of the Porcupine, like that of most purely vegetable-feeding Rodents, is very good, and is eaten in the countries where the animal occurs. When pursued or irritated, he stands on the defensive, erects his formidable quills and crest, stamps on the ground with his hind feet after the manner of a Hare, jerks himself towards the object of his dread, as if to wound it with his spines, and at the same time produces a curious noise by rattling the open quills of the tip of his tail. But all these manœuvres are generally in vain, and the Porcupine, in spite of his defensive armour, is pretty easily captured by those who know how to set about it. The Leopard is said to manage the business at once by a single blow of his paw on the head.

A very similar Porcupine (*Hystrix hirsutirostris*) takes the place of this species in Syria and Asia Minor, and extends thence eastward to India; another (*H. javanica*) inhabits the Sunda Islands; and the district of Nepaul has a peculiar species of its own. In Siam and Malacca, and on the west coast of Africa, we find two species of an allied genus, in which the spines of the body are comparatively short and depressed, and the tail is elongated, scaly, with a few scattered bristles in the middle, and with a large tuft of long flat bristles at the tip. The Malayan species (*Atherura fasciculata*) is about eighteen inches long, the African one (*A. africana*) about fourteen inches. Both are somewhat rat-like in their form.

The Tree Porcupines, forming the second sub-family, several species with prehensile tails, range over the continent of South America, east of the Andes, and one of them, the Mexican Tree Porcupine (*Sphingurus mexicanus*), is found as far north as Guatemala and Southern Mexico. The most abundant and widely-distributed species in the Brazilian region are the Couendou (*Sphingurus prehensilis*) and the Couiy (*S. villosus*), inhabiting Guiana, Brazil, and Bolivia, the latter being found throughout the forest region of Brazil and as far south as Paraguay.

These animals are of considerable size, usually measuring from sixteen to twenty inches in length without the tail, which is about one-third the length of the head and body. By the aid of the prehensile tip of this organ they climb with great facility and security upon the branches of the trees, but

TREE PORCUPINE.

their feet are also specially adapted for this particular mode of activity, and they are said even to climb the palm-trees in order to feed upon their fruit. They are nocturnal in their habits, passing the day in sleep concealed in the fork of a branch, and going abroad at night in search of their food, which consists of fruits of various kinds, and the buds, leaves, and even flowers, of the trees on which they live. Roots also form a part of their nourishment, probably when they reside rather among thickets than in the high forest. Their spines, although short when compared with those of the Common Porcupine, are formidable defensive weapons when the animal erects them; in some species, as especially in the Couiy, they are concealed, when depressed, by the long hair, and, according to Hensel, this serves as a protection to the animal from rapacious birds, for, when it sits in a heap, sleeping away the daylight, these soft grey hairs give it a most deceptive resemblance to a mass of the beard-moss which so commonly grows on the trees in the Brazilian forests.

The Urson, or Canada Porcupine (*Erythizon dorsatus*), the only North American species of the family, according to Mr. Allen, although other writers distinguish two or three such forms, is about two feet or more in length when full grown, and is covered with woolly hair, and with long coarse hair of a dark brown colour, with the points white or yellowish, this difference in the colour of the tips of the hairs being the chief distinction between the two varieties which Mr. Allen recognises. The spines in both forms are white, with the points usually dusky or brown. The Canada Porcupine is distributed through the whole of the Eastern United States, except on the seaboard, from New York to Virginia, and north of the States through Canada, as far as the limit of trees. The Western Porcupine, which has the tips of the long hairs yellowish (whence it has received the name *E. epixanthus*), occurs west of the Missouri river, extending to the Pacific shores and going southward along the mountains to Arizona and New Mexico, and northwards at least as far as Alaska and Sitka.

Although a heavy and clumsy-looking beast, and destitute of the prehensile tail of its South American cousins, this Porcupine is a good climber, and passes nearly the whole of its life upon trees; nevertheless, according to Mr. Allen, it may be met with travelling upon the prairies, probably on its way from one suitable residence to another. On the ground it moves slowly, but its armature of spines is a protection against most of its enemies, and it has the art of striking very forcible and judicious blows with its spiny tail. Audubon and Bachmann mention many cases in which Dogs, Wolves, and even a Puma were found dead or dying in consequence of the severe inflammation caused by the spines of this animal sticking about their mouths; and the former gives an interesting account of a lesson in

urbanity given by a captive Urson to a Mastiff that attacked him. The food of the Urson consists of various vegetable substances, fruits, buds, and the young shoots and leaves of trees. In the winter it

MEXICAN TREE PORCUPINES.

subsists chiefly upon the bark, which it strips off the upper branches of the trees, and when it has taken up its abode upon a tree it stays there until the suitable bark has been consumed. As it prefers young trees this operation is generally effected pretty quickly, and in this way it is estimated that a single

Porcupine may destroy hundreds of trees in the course of a winter. The Urson resides in the holes of trees, and in such situations, or in crevices among the rocks, the female prepares her nest, in which she brings forth usually two, but occasionally three or four, young in April or May.

FAMILY XIII.—CHINCHILLIDÆ (THE CHINCHILLAS).

In the Chinchillas, which form a small family peculiar to South America, the incisor teeth are short; the molars are rootless, divided by continuous folds of enamel into transverse plates, and the two series in each jaw converge towards the front; the zygomatic arch has no angular process on the lower margin; the clavicles are slender but perfect; the fore limbs are small, the hind limbs long; the tail of moderate length or long, and turned up at the end; and the fur is very fine and soft. They are Rodents of moderate size and more or less of Rabbit-like appearance, except that the tail is always elongated and bushy. Of the five known species, four are inhabitants of the mountain regions, and one lives in the plains of the region of La Plata.

The latter, the Viscacha (*Lagostomus trichodactylus*), is a stout-built and almost Marmot-like creature, from eighteen inches to two feet long, exclusive of the tail, which measures from six to eight inches. It has four toes on the fore limbs, and three on the hind feet, the latter furnished with long, compressed, and pointed nails; the muffle is broad and covered with a velvet-like coat of brown hair; the fur, which is soft and moderately long, is of a mottled grey colour above, and white or yellowish-white beneath; on each cheek there is a dark band; a white band crosses the muzzle and runs back on each side almost as far as the eye; the tail is dusky-brown or black.

The Viscacha lives on the Pampas from Buenos Ayres to the borders of Patagonia, and where it occurs is generally to be found in great numbers, residing in extensive burrows which it digs for itself in the ground, generally in the neighbourhood of copses, and, if possible, near cultivated fields. Each burrow has a great number of passages leading down to several chambers, in which the Viscachas live in family parties to the number of eight or ten. The Burrowing Owl already mentioned as an associate of the Prairie Dogs of North America, is found about the settlements of the Viscachas, living in their burrows, but it is said that the intrusion of these birds immediately drives out the real owners of the dwelling, as the Owls will not observe those rules of cleanliness which are characteristic of their unwilling hosts. Of course the expelled family has to make itself a new residence, and in this way great stretches of country come to be so undermined that they are dangerous to ride over. According to Mr. Darwin, the most favourite resort of the Viscachas in the neighbourhood of Buenos Ayres are those parts of the plain which, during half the year, are covered with great thistles.

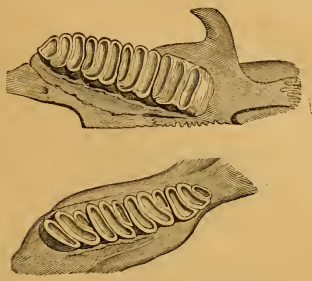
They are nocturnal in their habits, passing the day sleeping in the recesses of their burrows, and coming forth in the twilight one by one, until a large and lively company is to be seen playing about the neighbourhood of their holes. When all is quiet they go in search of their food, which consists of grasses and other herbage and roots, and sometimes of the bark of trees and shrubs. In cultivated fields they may do considerable damage. While engaged in feeding, one or other of the party is perpetually on the watch, and the moment anything occurs to cause alarm, the whole of them scamper away with their tails elevated, to take refuge in their holes. In their movements they are very like Rabbits, but less active.

The Viscacha has the very singular habit of dragging all sorts of hard objects to the mouth of its burrow, where bones, stones, thistle-stalks, hard lumps of earth, dry cow-dung, and other chance articles may be found collected into a heap, frequently, according to Mr. Darwin, amounting to as much as a wheelbarrow would contain. Mr. Darwin says that he was informed that "a gentleman riding on a dark night dropped his watch; he returned in the morning, and by searching in the neighbourhood of every Viscacha hole on the line of road, as he expected, soon found it." The purpose of this accumulation of apparently useless articles by the Viscacha has never been ascertained. It has been compared to the habit of some of the Australian Bower-birds, which adorn their playing-places with bright and glittering objects.

The Chinchillas of the Andes, or Alpine Chinchillas, are much lighter and more elegant animals than their cousins of the plains; in form they more resemble Squirrels or large Dormice. Their fur is excessively soft, perhaps the softest that clothes any animal, and in all the species it is of a grey

VISCACHAS.

colour, mottled or clouded with darker and lighter tints. The ears are of large size. They are confined to the Andes of Chili, Bolivia, and Peru, where they live among the bare rocks at a considerable elevation, seeking refuge in natural clefts and cavities, sleeping in their holes during the day, and coming forth at twilight in search of food. They are exceedingly lively and active in their movements, and very shy.



MOLAR TEETH OF THE CHINCHILLA.

The Common Chinchilla (*Chinchilla lanigera*), the skins of which are well known as furs, is a squirrel-like animal, nine or ten inches long, with a tail more than half this length. It has large rounded ears; its fore feet have five, and its hind four, toes. Its fur on the upper part is grey, elegantly marbled with dusky or black, on the lower surface yellowish-white; the tail is black above, and dirty white at the sides and beneath. The incisors are of a bright orange colour in front. The Short-tailed Chinchilla (*C. brevicaudata*), a larger species, has the tail only three inches long. Its fur is of a general silvery-grey hue, tinged with black, especially along the back, and the tail has two dark bands on its upper surface. Both these animals inhabit Peru, and the former is also found in Bolivia and Chili. They are exceedingly abundant, notwithstanding the constant persecution to which they are subjected for the sake of their skins. They come out of their holes even in the daytime, but then always keep on the shady side of the rocks. Their activity is described as wonderful, and they will run with great rapidity up perpendicular walls of rock which seem to offer no hold for their feet. On the ground they are said to run very much after the fashion of our common Mice.

CHINCHILLA.

The Chinchilla seems to breed nearly all the year round, and the female is said to produce from four to six young at a birth.

The other two species of Alpine Chinchillas are placed in a separate genus, characterised by a more hare-like form, longer ears, and the presence of only four toes on both fore and hind feet. Cuvier's Chinchilla (*Lagidium Cuvieri*) is about eighteen or twenty inches long, of an ashy-grey colour with a yellowish tinge above, and pale yellow beneath; the tail, which, with the hair, is nearly as long as the body is clothed beneath with short black hairs, and above with much longer bushy hairs, gradually increasing in length towards the tip, where they are black; a black line passes down the middle of the tail, and its sides are dirty white. The Pale-footed Chinchilla (*Lagidium pallipes*), which is about the same size as the preceding, but has a shorter tail, is ashy grey, with a brownish tinge, becoming yellowish fawn colour beneath. The range of these animals seems to be the same as that

of the true Chinchilla, but the second of them passes northwards into the mountains of Ecuador. In their habits they agree with the Chinchillas.

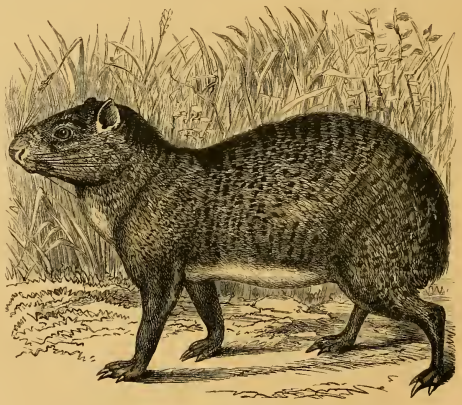
FAMILY XIV.—DASYPROCTIDÆ (AGOUTIS).

In the Agoutis we have the first of three more or less pig-like families, furnished with hoof-like nails on the toes, all the members of which are inhabitants of South America. The Agoutis especially may be compared to small slender-limbed Pigs, but they bear a still closer resemblance in external form to the little Musk Deer. The Dasyproctidæ have the incisors long; the molars, which are at first rootless, and afterwards close up, have enamel folds from both surfaces; the clavicles are rudimentary; the upper lip entire; the ears short; the tail short and naked, or quite rudimentary; and the fore feet have five toes.

MOLAR TEETH OF THE AGOUTI.

Of these animals eight or nine species are known. They inhabit South America, from Mexico southwards to Paraguay and Bolivia, and some of them also occur in the larger West Indian Islands. They frequent the forest region, and especially haunt the banks of rivers.

The AGOUTI (*Dasyprocta aguti*), the most abundant and best-known species, is found chiefly in Guiana, Brazil, and eastern Peru, where it is to be found plentifully in the primeval forests. Like the other true Agoutis, it has only three toes on the hind foot; its ears are of moderate size and rounded; its form compact, and supported upon slender limbs; its tail rudimentary; and the hair of its back is coarse and harsh, and longer towards the hinder parts, which thus obtain a somewhat truncated appearance. Its general colour is olive brown, produced by a mixture of black and yellow; but the long hairs covering the hinder portion of the back are usually of an orange colour, and the middle line of the abdomen is whitish or yellow. This animal is from eighteen to twenty inches long.



AZARA'S AGOUTI. (From the *Proceedings of the Zoological Society.*)

Although inhabiting the forests, the Agouti is not unfrequently seen on the neighbouring grassy plains, but its residence is among the trees, in the hollows of which, or in cavities at their roots, it takes up its abode, generally lying concealed in its retreat during the day. It is very quick in its movements, runs well, and springs with almost the agility of an Antelope. The food of the Agouti consists of almost any vegetable substances that come in its way. It will eat grass and herbage, the roots of plants, their flowers and fruit, and when it lives in the neighbourhood of sugar plantations

and gardens its inroads may give rise to considerable injury. The animal is, however, rather solitary in its habits, living by itself in its cell, in its departure from and return to which it appears generally to follow exactly the same roads, by which means a narrow but very distinct footpath is in course of time produced. This naturally often leads to the discovery and capture of the little recluse.

The Agouti appears to breed all the year round, usually producing two young ones at a birth. The female prepares her dwelling for the reception of her family by lining it comfortably with leaves, fine roots, and hair.

In the southern parts of Brazil, in Paraguay and Bolivia, the place of this species is taken by Azara's Agouti (*Dasyprocta Azarae*). A smaller species, the Acouchy (*D. acouchy*), is found not only in Guiana and the north of Brazil, but also in several of the West India Islands. The last-named species has a well-developed tail about two inches long.

SKULL OF THE PACA.

Besides the Agoutis, this family includes an allied animal, the Paca (*Cœlogenys paca*), which differs generically from the Agoutis by having five toes on the hind feet. It has a broader head and a blunter muzzle, and is altogether a rather stouter animal than the Agoutis; but, like most of them, it has a mere tubercle instead of a tail. One of the most remarkable characters presented by this animal, however, is the enormous development of the zygomatic arches, which are enlarged and inflated in the most extraordinary manner, the maxillary portion, which occupies the anterior two-thirds being hollowed out beneath into a great chamber, lined with mucous membrane, and opening into the mouth by a rather small aperture. The function of these remarkable cavities is at present quite unknown. Food is not to be found in them, and, indeed, as they are enclosed by solid bone, it would seem impossible that they could act as cheek-pouches.

The Paca, which inhabits Central and South America from Guatemala to Paraguay, is about two feet long, and is clothed with short rather coarse hair of a brown or yellowish-brown colour above, white beneath, with from three to five bands of white streaks and spots upon each side

PACA.

of the body. In its habits the Paca very much resembles the Agouti. It usually lives singly, or sometimes in pairs, on the borders of the forests, or near the banks of rivers, taking up its abode during the day either in a hole at the root of some tree, or in a burrow excavated by its own labour, which is generally carried to a depth of four or five feet. Its food consists of the leaves, fruits, and flowers of various plants, and, like the Agouti, it occasionally does mischief in the corn-fields and gardens. The female produces only one, or at most two, young at a birth. The Paca swims well, and can cross even a broad river in this way. Its flesh, like that of the Agouti, is very well flavoured, and is consumed both by natives and Europeans.

FAMILY XV.—DINOMYIDÆ.

This family has been founded for the reception of a single species, of which only a single specimen has hitherto been obtained. It is described by Professor Peters under the name of *Dinomys Branickii*. In its external appearance it closely resembles the Paca (*Cœlogenys paca*), but may at once be distinguished from that animal by its possession of only four toes both before and behind. The ears are short and rounded; the upper lip deeply cleft; the incisors very broad; the molars four on each side, and divided into transverse plates by folds of enamel; the clavicles are imperfect; and the tail of moderate length and well clothed with hair. The animal, which inhabits the high mountain regions of Peru, is of the size of the Paca, or about two feet long, exclusive of the tail, which measures rather more than nine inches. Its general colour is grey, produced by the sprinkling of white among nearly black hairs; and on each side of the body are numerous large white spots, of which the upper ones nearly run together, so as to form two longitudinal bands. The extremity of the tail is black.

The only known example of this Rodent was obtained by M. Constantin Jelski at the Colonie Amable Maria, on the Montaña de Vitoc, in Peru, having been found at daybreak walking about the yard. It showed no fear of man, and was easily killed by a sword cut or two on the head. The species would appear to be rare, as the inhabitants of the neighbourhood were not acquainted with it. Of course nothing is known of its habits.

THE DINOMYS. (*After Peters.*)

The chief interest at present attaching to this animal, therefore, consists in its peculiar combination of characters. Externally, as already stated, it resembles the Paca, with which it also agrees in the S-like form of the nostrils, and in the structure of the limbs (except the number of toes). In the lamellar structure of the molar teeth, in the structure of the skull, and of the skeleton generally, and especially in the flattened form of the front of the sternum and the development of clavicles, it differs from the Paca and all other Rodents with hoof-like nails. In some minor particulars it resembles the Capybara. By the structure of the molar teeth and certain osteological characters, it is most nearly allied to the Chinchillas; while it approaches the genus *Capromys* among the Octodontidæ in

the structure of the limbs and of some other parts of the skeleton. Professor Peters is evidently inclined to regard it as most nearly related to the Chinchillidæ, but as constituting a group establishing a closer union than previously existed between the families Chinchillidæ, Octodontidæ, Dasyproctidæ, and Caviidæ.

FAMILY XVI.—CAVIIDÆ (CAVIES).

This family, the last of the simple-toothed Rodents, includes a small number of species, of which the Common Guinea-pig may serve as a sort of type. The Guinea-pig is, however, one of the smaller species of the family, and is shorter in the limbs than most of its relatives. They have the incisor teeth short, that is to say, not extending far back in the jaw; the molars are rootless, variously divided by folds of enamel into lobes, the angles of which are acute; the palate is narrow in front, so that the upper series of molars approach each other rather closely in front; the clavicles are rudimentary or wanting; the fore limbs have four and the hind feet only three toes, all armed with hoof-like nails; the upper lip is not cleft; and the tail is rudimentary or wanting. They are stout, more or less rabbit-like animals, with a soft coat, and the ears variable in length; and they are confined to the continent of South America, where they chiefly inhabit the plains.

The Restless Cavy (*Cavia aperea*), which is commonly regarded as the wild original of the so-called Guinea-pig (*Cavia cobaya* of some authors), is abundant on the banks of the Rio de la Plata, and extends thence northwards through Paraguay into Bolivia and Brazil. It is usually about nine inches long, with the fur of the upper part and sides of the body composed of a mixture of black and dingy yellow hairs, the chest greyish-brown, and the throat and belly pale dingy-yellow or brownish-grey. The incisor teeth are white. The genus to which this animal belongs may be at once distinguished from the other two genera constituting the family by the shortness of the limbs; the ears also are short; the feet are naked beneath; the hind toes are not webbed; and the molar teeth are nearly equal in size, and each composed of two angular lobes.

The specific name of the Restless Cavy seems to be derived from its popular name in the country where it occurs. According to Mr. Darwin, it is very common about the banks of the La Plata, sometimes frequenting sandy hillocks, and the hedge-rows formed of the agave and the prickly pear, but apparently preferring marshy places covered with aquatic plants. In dry places it makes a burrow; but when it frequents wet localities contents itself with the concealment afforded to it by the herbage. Rengger describes it also as generally haunting moist situations in Paraguay, and he adds that it keeps near the borders of forests, but is never found either in the forests or in the open fields. It lives in small societies of from six to fifteen individuals, in the impenetrable thickets of Bromelias, where its presence is revealed by the numerous beaten paths which it produces by going to and fro. In Bolivia, according to Mr. Bridges, it is peculiar to the low lands, and there takes shelter among the loose stones of the walls enclosing the fields. It is active in search of food early in the morning and in the evening, but will also come forth on gloomy days. Rengger and Azara both agree in the statement that the female produces only one or two young at a time; but the former says that this takes place only once in the year, whilst the latter describes the animal as breeding all the year round, and, indeed, in this way accounts for its abundance, notwithstanding its being preyed upon so extensively by rapacious birds and quadrupeds.

The question whether our common Guinea-pig is really the domesticated descendant of the animal just described can hardly be regarded as finally settled, and, indeed, independently of colour, there are sufficient differences between them to justify some doubt on the subject. The name Guinea-pig may, as Mr. Waterhouse suggests, be a mistake for Guiana-pig, and the first specimens may very probably have come from that part of America. Its prevalent colours, as is well known, are combinations of white, black, and yellow, and as these colours are shown in the drawings of Aldrovandus, dating back to within fifty years of the discovery of South America, there seems every reason to believe that the animal must have been long domesticated in America prior to its introduction into Europe. On the other hand, Dr. Rengger says that he saw fourteen Apereas representing the fifth or sixth generation from a single couple domesticated about seven years before, and that these exhibited no

difference of colouring from the wild animal. Several allied species inhabit the great plains of South America.

The Bolivian Cavy (*Cavia boliviensis*), which is grey in colour, with a faint yellowish tinge, with the throat and belly white, the feet whitish, and the incisor teeth orange yellow, inhabits the elevated parts of Bolivia, generally at a height of 10,000 or 12,000 feet. The Rock Cavy (*Cavia rupestris*) is found in rocky districts in Brazil, where it shelters itself in holes and crevices. It is always found near the upper waters of rivers, and is a large species, measuring thirteen or fourteen inches in length. The Southern Cavy (*Cavia australis*), on the other hand, is a small species which inhabits Patagonia, where it ranges from 39° S. lat. to the Strait of Magellan.

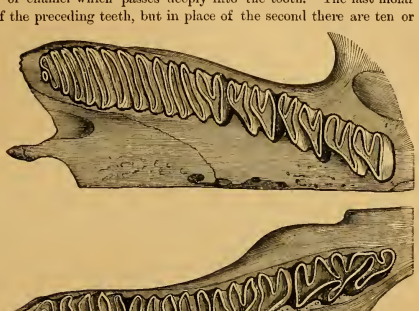
This part of the world is also the abode of another and much larger species of the family, the Patagonian Cavy or Mara (*Dolichotis patachonica*), an animal which somewhat resembles the Agouti in the length and comparative slenderness of its legs, and differs from all other Cavies in having tolerably long, pointed ears. It also possesses a very short tail. The molar teeth are rather small, and resemble those of the Guinea-pig in being formed of two nearly equal angular lobes, but the last molar in the upper jaw, and the first in the lower jaw, have three such lobes. The animal is somewhat Hare-like in its appearance, and has been mistaken for a Hare by superficial observers. It is, however, a much larger animal, measuring from thirty to thirty-six inches in length, and weighing from twenty to thirty-six pounds.

PATAGONIAN CAVY.

The Patagonian Cavy is clothed with a dense crisp fur of a grey colour on the upper part of the head and body, rusty yellow on the flanks, and white on the chin, throat, and belly; the rump is black, with a broad white band crossing it immediately above the tail. It inhabits Patagonia about as far south as 48°, and extends northwards into the La Plata territory as far as Mendoza. It is found only in the sterile desert part of the country, where the gravelly plains are thinly covered with a few stunted thorny bushes and a scanty herbage. The northern limit of the species, according to Mr. Darwin, is at the point where the vegetation of the plains becomes rather more luxuriant. The Patagonian Cavy usually burrows in the ground, but where it lives in the same region as the Viscacha, it will take advantage of the excavations made by that animal. It wanders to considerable distances from its home, and on these excursions two or three are usually seen together. Mr. Darwin says:—"It is a common feature in the landscape of Patagonia to see in the distance two or three of these Cavies hopping one after the other over the gravelly plains." Their mode of running, on the same authority, more nearly resembles that of the Rabbit than of the Hare; though their limbs are long, they do not run very fast. They rarely squat like a Hare, but are very shy and watchful, and feed by day, in connection with which it is to be observed that the eyes are defended from the direct rays of the sun by well-developed eyelashes, which do not occur in the other Cavies. The female produces generally two young at a birth, which are brought forth and suckled in the burrow.

The Capybara (*Hydrochœrus capybara*), the only other member of the present family, is the largest of all existing Rodents, large specimens measuring over four feet in length. It is a stout-built and massive animal, with limbs of moderate length, a large head with a very blunt muzzle, small

eyes and ears, no tail, and both the fore and hind feet webbed. The upper incisor teeth have a broad and shallow groove down the front, and the molars present very remarkable characters. In the upper jaw the first three molars are each composed of two lobes united by cement, and on the outside of each of these lobes there is a fold of enamel which passes deeply into the tooth. The last molar consists of one lobe similar to those of the preceding teeth, but in place of the second there are ten or a dozen transverse plates. The first two molars of the lower jaw exhibit complex lobes and folds of enamel; the third and fourth a combination of folded lobes and transverse plates.



MOLARS OF THE CAPYBARA.

In its general form the Capybara is more pig-like than any of its relatives, and, indeed, its generic name, *Hydrochœrus*, Water-pig, recalls this resemblance, and at the same time intimates its aquatic habits. Its coat is composed of long and coarse hairs, often five or six inches long on the hinder parts, of a reddish-brown colour above, and a dirty brownish-yellow beneath. It is distributed over the whole eastern part of South America, from Guiana southwards to the Rio de la Plata, and ranges westwards into the lower parts of Peru and Bolivia.

The Capybaras frequent the borders of the lakes and rivers, with which all this part of the South American continent abounds, and, according to Mr. Darwin, they used to frequent the islands in the mouth of the La Plata, where the water is quite salt. In this part of America they are called "Carpinchos." They never wander far from the water-side, and show a marked preference for the larger rivers, among the reeds and other plants fringing which they take up their abode. In populous districts they seem to pass the day in concealment, coming forth in search of food only at morning and evening, but where they are less in danger of pursuit they come out freely in the day-time. Seen from a little distance when walking they have much the appearance of Pigs, but they lose this when they sit, like the other Cavies, on their haunches. When danger threatens they emit a short, sharp bark, and immediately plunge into the water, where they swim about with little more than the nostrils above the surface; but under pressing circumstances they can dive and swim for a considerable distance under water. When swimming, the female is said to take her young ones on her back. About Maldonado Mr. Darwin observed that the Capybaras were usually to be seen only three or four together, but they are more numerous and go in larger companies more in the interior of the country. They constitute the ordinary food of the Jaguar, and are also eaten by the Indians, although their flesh is said not to be very good. The female produces five or six young at a birth, but has only one litter in the year. The young follow their mother about at a very early age.

SUB-ORDER II.—DOUBLE-TOOTHED RODENTS.

With the Cavies concludes the long series of simple-toothed Rodents, and some of them, as we have seen, present no small resemblance to the Hares and Rabbits which constitute the greater part of the second great group into which we have divided the order. The chief peculiarity of this section, as has been already stated, consists in the presence in the upper jaw of a pair of minute incisor teeth, placed immediately behind the large effective incisors; and in the newly-born animal the number of these teeth is even greater, there being six incisors in the upper jaw, two of which fall

CAPYBARA.

out at an early period. Though the number of species included in this section is very considerable (about fifty, according to Mr. Wallace's estimate), it includes only two families, and each of these contains only a single genus. We will commence with that which includes the best-known forms, the Hares and Rabbits.

FAMILY XVII.—LEPORIDÆ (HARES AND RABBITS).

The general appearance of these animals hardly needs to be described, and we may, therefore, indicate merely the structural peculiarities which serve to define the family. These consist in the presence of six rootless molars on each side in the upper, and five in the lower jaw (*see* figure on p. 82), each molar being divided into lobes by transverse folds of enamel; in the compressed form of the skull and the presence of wing-like post-orbital processes of the frontal bones; in the imperfect condition of the clavicles; the greater development of the hind limbs; and the presence of a short, bushy, upturned tail. The ears are long; the inner surface of the cheeks is more or less clothed with short hairs; the fore-limbs have five, and the hind-limbs only four toes; and the soles of the feet are hairy throughout. In all these characters, however they may differ in some respects, all the true Hares and Rabbits agree. The representatives of this family occur in nearly all parts of the world, but chiefly in the northern hemisphere, and the few species which pass down within the tropics are generally found only in mountainous regions. In the north they reach the Arctic regions in both continents. In the Old World a few species are scattered over India and Further India, and four or five occur in Africa, but chiefly in the southern part of the continent. In North America the species are numerous, and some of them range southward into Central America; but South America has only a single species, which occurs in the mountains of Brazil and upon the Andes.

As the whole of the family consists of animals to which in common parlance the names of Hares and Rabbits are given, we may take as examples of it the Hares and Rabbits which are so abundant in Great Britain, the other species agreeing generally with one or other of them in character and habits.

They may all be characterised as animals destitute of any means of defence against their enemies, except the rapidity of their movements, and as exceedingly shy and timid. Their general colour is a mixture of grey and brown, sometimes quite tawny, sometimes almost pure grey, and, as Mr. Bell remarks, "The admirable wisdom which has assigned such colours to a group of defenceless animals which conceal themselves amidst the brown sombre vegetation of woods and heaths, will appear more striking when it is recollected that certain species inhabiting the snowy regions of the north become wholly white in winter. All the members of the genus," he adds, "are remarkable for their timidity, and their whole structure is such as at once to announce to them the presence of danger, and to enable them to escape from it. The eyes and ears are so formed and situate as to become instantly cognisant of even distant warnings of peril, and the limbs are admirably adapted for the most rapid flight."

This last statement applies in a special manner to the COMMON HARE (*Lepus europæus*), which is singularly well adapted for getting over the ground rapidly by the great length and powerful development of its hind legs. These organs are nearly twice as long as the fore limbs, and, as most of us are well aware, the bones composing them are set in motion by an enormous mass of solid muscle. Owing to their great preponderance the Hare, when moving slowly in search of food, goes with a sort of lolloping gait; but the moment there is occasion for him to move with rapidity, the disproportionate hind limbs stand him in good stead, and he shoots along over the ground by a series of long leaps, and with great swiftness. At the same time, it is observed that the length of its hind legs causes the Hare to run with much greater facility up hill than down, and, in fact, it is said that in descending steep inclines the animal is obliged to run obliquely in order to escape over-balancing itself. When pursued, the Hare has the art of making sudden turns in its course, known as "doubles" or "wrenches," by which the Dogs in chase of it are thrown out, for although most Greyhounds are swifter of foot than a Hare, they are incapable of changing their course so sharply, and thus, while they are carried some distance onwards by their own impetus, their intended victim is making off in a different direction. They adopt other cunning artifices in order to escape from their pursuers, and some of these indicate a considerable amount of intelligence. Under such circumstances, and also in search of a more plentiful supply of food, the Hare will take to the water readily, and swim across rivers. Mr. Yarrell observed a Hare even swimming across an arm of the sea about a mile broad.

The Hare lives chiefly in cultivated fields, where it resides in a small depression of the surface, which is called its "form." It shifts the situation of this simple residence according to the season, selecting a shady spot in summer, and a sunny one in winter, and going into cover in wet weather. It is rather a nocturnal or crepuscular than a day-feeding animal, although it may not unfrequently be seen abroad in the day. In the evening and early in the morning it is most active, passing the brighter hours at rest in its form. When out in the field in search of food it goes hopping along among the herbage and cultivated plants, every now and then sitting upright on its haunches and listening with erected ears for the slightest sound indicative of approaching danger. Its food is exclusively of a vegetable nature, but it seems to embrace pretty nearly the whole round of cultivated plants. Cruciferous plants appear to be amongst its favourite articles of diet, but it also does much damage to fields of young wheat. In the winter, when the open fields are covered with snow frozen hard, and, indeed, sometimes in the summer, the Hare will make his way into gardens in search of food, or, if this resource is not at hand, into plantations of young trees, where it will gnaw off and feed upon the bark, thus destroying great numbers of the trees. Mr. S. Mawson has recorded finding the stomach of a Hare killed in winter filled with hawthorn berries. After its wanderings the Hare always returns to its own form.

Hares pair when they are about a year old, and from that time produce several broods every year, each consisting of from two to five young, which are born covered with hair and with their eyes open. From Mr. Bell's statement, these animals would appear to breed almost all the year

round; he says that in mild winters young Hares have been found in January, and that he has known breeding continue till the middle of November. When captured young, the Hare may be easily tamed, and become an amusing pet, as, indeed, will be familiar to almost every one, through Cowper's account of his Hares. Formerly the Hare used to be trained by jugglers to perform various tricks, one of which was the beating of a tambourine with its fore-feet, with which the animal will of its own accord drum upon the back of an offending companion. A relic of this practice is to be recognised in a common toy, which shows a small Hare sitting and beating a tambourine, its fore limbs being set in motion by the turning of the wheels of its stand.

The Common Hare is found spread over the greater part of Europe, from the south of Sweden and northern Russia to the Mediterranean and the Caucasus. It does not occur in Ireland. It varies somewhat in colour in different localities, and although it does not become white in winter, the northern forms show a tendency in that direction, and the others acquire a greyish tint at the approach of the cold weather.

The Rabbit, or Cony (*Lepus cuniculus*), differs from the Hare in various characters; its colour is a tawny brownish-grey, the disproportion between the fore and hind limbs is not so great, and the ears are shorter, not exceeding the head in length. Although the Wild Rabbit is so plentiful in England as to become a pest to the farmers in many places, it is supposed not to be a native of north-western and central Europe, but to have been naturalised in Britain, its original home being in the countries bordering the Mediterranean. It is, and always was, very abundant in Spain, the name of which country (Hispania) has been supposed to mean the "country of Conies," from the Phœnician and Hebrew word *Schaphan*, the name of the Hyrax or Cony of the Bible. Even in the present

COMMON HARE.

day it is very local in its distribution north of the Alps, and is not found at all in eastern and northern Europe. In Australia it has proved to be a veritable scourge.

In its habits the Rabbit differs from the Hare more than in its form and structure. Instead of contenting itself with a shallow depression as a resting-place on the surface of the ground, it digs deep holes in the ground, into which it may retire to sleep or at the approach of danger. It prefers light sandy soils for its residence, as these present great facilities for burrowing, and wherever particularly favourable conditions exist the Rabbits are to be found living together in very large societies. Furzy heaths are favourite places with them, as the ground is easily worked, and the furze bushes not only serve as a protection to the burrows, but furnish the Rabbit with an abundant supply of food, the young shoots being eaten off as high as the animals can reach when standing on their hind feet. In wet moors the Rabbits avoid burrowing, and live in runs and galleries formed in the matted heather and long herbage. Mr. Bell says that in more than one instance he has known a family to take possession of a hollow tree, ascending its inclined and decayed trunk for some distance.

Like the Hare, the Rabbit is generally quiet during the day, although it will not unfrequently be abroad at all hours. The evening, however, is its principal time for activity, and then the inhabitants of the warren may be seen playing about near their abodes, or wandering to greater distances in search of the green vegetables on which they feed. The moment there is the smallest suspicion of danger, the whole company scamper off at once to seek safety in their burrows. As they go, their white tails are the most conspicuous objects to be seen, and the spectacle of some hundreds of them rushing along at full speed, vanishing one after the other down the burrows, is lively and amusing enough.

The Rabbit begins breeding at six months old, and has several litters in each year. The young are usually from five to eight in number, sometimes even more; they are born blind and naked, and are produced in a separate burrow which the female digs for their reception, and lines with fur pulled from her own body. This brood-chamber has usually only a single entrance, and this the mother closes with earth after visiting and suckling her young family, which she is said to do only at night.

When domesticated, the Rabbit, as is well known, differs materially from its wild state. It is larger, and its colours are usually white, black, brown, or fawn colour, sometimes alone, sometimes mixed in patches. Albinoes are common, and form a permanent race. The Angora Rabbit, which is usually albino, has the hairs very long; and the so-called "fancy Rabbits" have the ears more or less pendent at the sides of the head, and often so long as to touch the ground.

A third British species is the Mountain Hare (*Lepus variabilis*), or Northern Hare, an inhabitant of all the northern parts of both hemispheres, which occurs in most parts of Scotland, and in Ireland, where, indeed, it takes the place of the common Hare. In its summer coat it is of a light fulvous grey colour, and is further distinguished from the common Hare by the shortness of the ears and tail, the former being shorter than the head, and the latter little more than half its length. In cold climates this animal becomes pure white in the winter. This Hare is absent from Central Europe, but reappears on the chain of the Alps.

It will be unnecessary to enter into details with regard to the other species of this family, all of which more or less resemble those just described, both in appearance and habits. They are distributed over nearly the whole world except the Australian region, but they are most numerous in North America, where a great many species have been described, which are reduced by Mr. Allen to twelve. Four of these, however, present well-marked local races, which double the number of recognised permanent forms.

FAMILY XVIII.—LAGOMYIDÆ (PIKAS).

In many respects the Pikas closely resemble the Hares, but they are distinguished by having only five molars on each side in each jaw, a depressed skull, with contracted frontal bones destitute of the wing-like process seen in the Hares, complete clavicles, short ears, limbs nearly equal in length, and no tail visible externally. They are much smaller than any of the Leporidæ, the largest being no larger than a Guinea-pig, to which the animals have some resemblance; while in their habits they somewhat resemble the Marmots. When feeding they often produce a chirping or whistling noise, whence the name of Piping Hares, or Calling Hares, has been applied to them. Ten or a dozen supposed species of these animals have been described, most of them

inhabiting the northern and mountainous parts of Asia, and one of these is also found in Europe, about the southern part of the Volga. In Asia species have been found as far south as the Himalayas and Nepaul. In North America a single species (*Lagomys princeps*) inhabits the Rocky Mountains, where it was first discovered by Sir John Richardson.

The Alpine Pika (*Lagomys alpinus*), which inhabits Siberia from the Irtish eastwards into Kamtchatka, is a little animal from nine to nine and a half inches long, of a greyish-brown colour above, yellowish-grey beneath; the feet are pale, and the ears dirty yellowish-white within, becoming dusky towards the margin, which is white. This animal occurs in considerable numbers in the Alpine and sub-Alpine parts of Siberia, where it either burrows in the ground, or shelters itself in crevices of rocks or among loose stones. The Pikas generally come out only at night, although they sometimes venture forth on a cloudy day. Their food consists of the scanty herbage to be found in their elevated abode, and as this would be impossible to procure during the winter when the ground is thickly covered with snow, the Pikas take care in the autumn to collect a large supply of dried grasses and other herbage, which they pile up near their habitations like little haystacks. They are, however, sometimes deprived of the fruits of their labour by the Sable-hunters, who plunder the Pikas' stacks to feed their Horses. The female produces about six naked young early in the summer.

ALPINE PIKA.

The Rocky Mountain Pika (*Lagomys princeps*) is a small species from six inches to seven and a half inches long, of a greyish-brown colour above, yellowish-brown on the sides, and greyish below. It received its specific name from its discoverer, Sir J. Richardson, in allusion to the name of "Little Chief Hare" given to it by the Indians. It inhabits the summits of the Rocky Mountains from Colorado northwards far within British America, and also occurs in the mountains of Utah, California, and Oregon. Mr. Allen describes its habits as follows:—"The animals are everywhere found in communities, living among the loose rocks from a little below timber-line nearly up to the snow-line. They appear to rarely wander many yards from their homes; are timid, yet easily become familiar. Though retreating to their homes when first alarmed, they soon come cautiously out one after another, till one may hear their sharp little cries in every direction. Their colour so nearly resembles that of the rocks they live among, that they are not easily seen, and their cry is of such a character as easily to mislead one in respect to the point from which it proceeds, seeming to be far away when only a few feet distant. They sit erect, like little Marmots. . . . They carry into fissures of the rocks large quantities of grass, which they lay up for winter consumption."

CHAPTER V.

FOSSIL RODENTIA.

Families of Rodent represented by Fossil Remains—State of the "Record of the Rocks"—The Sciuridæ—Sciurine Genera now Extinct—No Fossil Anomaluridæ and Haplodontidæ—Ischyromyidæ—*Pseudotomus hians*—*Gymnoptychus*—Castoridæ—Mr. Allen's Castoroididæ—The Myoxidæ—No Fossil Lophiomyidæ—The Muridæ—The Spalacidæ—The Geomyidæ—The Dipodidæ—The Theridomyidæ—The Octodontidæ—The Hystricidæ—The Chinchillidæ—The Dasyproctidæ—The Caviidæ—The Leporidæ—The Lagomyidæ—*Mesotherium cristatum*—Difficulties concerning it—Mr. Alston's Suggestion—The Hebetidentata—Teeth—Skull—Skeleton—Conclusions regarding it—Table of Rodent Families—Concluding Remarks.

The majority of the preceding families are more or less clearly represented by fossil remains, either in the younger strata of the earth's crust, or in those cave-deposits of comparatively recent date which have furnished so many interesting relics of the Mammals of former days. It must be remarked, however, that while a considerable number of fossil Rodents have been named and described by palæontologists, the materials upon which many of them have been established are very imperfect; in a great number of cases isolated molar or even incisor teeth furnish the sole evidence of the existence of creatures which were manifestly Rodents, but of which the other characters are rather difficult to divine from such scanty material. Still, imperfect as may be "the record of the rocks" in this as in other instances, it is in some parts sufficiently complete to enable us to trace back the existence of many forms of gnawing Mammals through a long period of geological time.

Of the Sciuridæ a considerable number of fossil species have been recorded. Species of the genera *Sciurus*, *Arctomys*, and *Spermophilus*, some of them identical with those still existing, have left their remains in Post-Tertiary deposits and in bone-caves in various parts of Europe; while species belonging to the first two genera, and to the American genus *Tamias*, have been detected in similar situations in North America. A few forms referred to the same genera go down still lower in the series of geological formations. True Squirrels are recorded from Miocene and Upper Eocene deposits in France, and a single species from the Tertiaries (probably Miocene) of Colorado; Marmots from Pliocene and Miocene beds in the South of France, and from a Pliocene deposit in Nebraska; and a Spermophile from the Miocene of Weisenau in Germany.

Besides these examples of known types, several fossils have been obtained both in Europe and America, which are regarded as indicating genera distinct from any now living. *Plesiarctomys Gervaisii* is founded on a fragment of jaw with four molars, obtained from Upper Eocene beds near Apt, Vaucluse. In its characters it appears to be intermediate between Squirrels and Marmots. *Pseudosciurus suevicus*, from the Upper Eocene (Bohnerz) of Würtemberg, seems to differ from all other Sciuridæ in the form of the molar teeth of the lower jaw, which are somewhat elongated, and have four tubercles arranged in two pairs, each pair being connected by a ridge. From the Tertiary deposits of the western territories of the United States, Professors Cope, Marsh, and Leidy have described several Sciurine Rodents as belonging to genera now extinct: thus *Paramys* has five species; *Sciuravus* (perhaps identical with the preceding), three; *Heliscomys*, *Mysops*, *Colonymys Taxymys*, and *Tillomys*, one or two species each.

Of the Anomaluridæ and Haplodontidæ no fossil remains are known. On the other hand, a North American fossil Rodent, described by Dr. Leidy under the name of *Ischyromys typus*, is regarded by Mr. Alston as the type of a distinct family, the Ischyromyidæ, nearly allied to the Sciuridæ, but also showing an affinity to the Beaver in some of its characters. The specimen described and figured by Dr. Leidy was obtained by Dr. Hayden from Miocene deposits in the "Bad Lands" of Wyoming. It was originally referred to the Sciuridæ, with which it agrees in its dentition, but is distinguished by its large infra-orbital opening, the presence of a sagittal crest, and the absence of post-orbital processes. The parietal region of the skull is much narrowed, and in this, as in the large size of the infra-orbital opening, *Ischyromys* resembles the Musk Rat.

Two other forms must be referred to here. Under the name of *Pseudotomus hians*, Professor Cope has described the remains of an animal which he believed to have been about the size of an Agouti, and originally thought to belong to the order Edentata. Subsequently he referred it to the Sciuridæ; but both Mr. Alston and Mr. Allen think that it may belong to the family Ischyromyidæ. In some

respects the skull resembles that of *Arctomys*, but it has the same contraction between the orbits as *Ischyromys* and *Fiber*. The incisor teeth are separated, and Professor Cope believes that the animal had only three molars on each side in each jaw. A still more doubtful member of the family is Professor Cope's genus *Gymnoptychus*, which includes four species, all said to be from the "Tertiary of the Plains." In this genus there are five molars above and four below on each side, as in *Ischyromys* and the Sciuridæ; but these teeth show two crescents on the inner side in the upper, on the outer side in the lower jaw, and each crescent gives origin to a cross-ridge running to the opposite margin of the tooth.

The Castoridæ, including at present only a single species common to the northern parts of both hemispheres, are represented by several peculiar fossil forms. Remains of the Common Beaver (*Castor fiber*) are not uncommon in peat bogs and other late superficial deposits both in Europe and America; and, according to Sir R. Owen, in association with those of the Rhinoceros, Mammoth, and Mastodon, even in the Fluvio-marine Crag (Newer Pliocene) of Norfolk. In Belgium its bones have been found in caves. Among the Mammals from the Upper Tertiaries of the Sivalik Hills, Messrs. Falconer and Cautley record a Beaver distinct from the existing species, although nearly allied to it. The skull of a great Beaver, one-fifth larger than that of the living species, was obtained many years ago by M. Fischer from sandy deposits on the shores of the Sea of Azov, and, as it differed in some peculiarities of the teeth from *Castor fiber*, was described by him as constituting a distinct genus under the name of *Trogontherium Cuvieri*. It is now regarded as a true Beaver, and named *Castor Trogontherium*. The British species, described and figured by Sir R. Owen from the Norfolk Forest bed under the name of *Trogontherium Cuvieri*, is, however, quite distinct, and belongs to the genus *Diobroticus*, characterised by having the third upper and first lower molar teeth with four enamel folds, and the rest only with two, most of the folds soon becoming isolated as the teeth wear down. This animal must have been nearly twice the size of the European Beaver.

At a still earlier period—namely, in the Miocene—the family Castoridæ was represented, both in Europe and America, by some small species, nearly agreeing with the Beavers in dentition, but differing in the characters of certain bones of the skull. These form the genus *Steneofiber*. The largest (*S. viciacensis*), from the Miocene of the Allier, was about half the size of the Beaver; another (*S. sansaniensis*), from the fresh-water limestone of Sansan, was about as large as a Rat; an American species (*S. nebrascensis*), from the "Bad Lands" of Dakota, was rather smaller than a Marmot, and presented some resemblance to the Agoutis in the characters of the teeth; and a fourth species (*S. pansus*) occurs in the Santa Fé marls. *Eucastor tortus*, a species rather smaller than a Marmot, is described by Dr. Leidy as very nearly related to the Beaver. Its remains were found in loose sands of the Niobrara River, Wyoming. *Chalicomys* and *Palæomys* are genera doubtfully placed here. Their species occur in the Miocene and Pliocene of Europe.

Some bones of a gigantic Rodent, indicating an animal as large as a full-grown Black Bear, obtained from Quaternary and Alluvial deposits of various parts of the United States, have been described under the name of *Castoroides ohioensis*, Mr. J. W. Foster, its first describer, having an idea that it was a great Beaver. It has generally been known as the "Fossil Beaver" of North America, but several authors have entertained doubts of the correctness of this designation, and Mr. Allen has lately made it the type of a special family, Castoroididæ, which he regards as most nearly related to the Chinchillidæ. In the general aspect of the skull it resembles the Beaver, but in several details of structure approaches the Viscacha; while the structure of the molar teeth, which consist of a series of plates of dentine, completely enclosed by enamel, and held together by a thin coating of cement, occurs elsewhere only in the Chinchillidæ, and in the last molar of the Capybara.

Dormice as well as Squirrels disported themselves in the Tertiary woods and thickets of Europe, and remains of several species of Myoxidæ occur in various deposits in France, Switzerland, and elsewhere, from the Upper Eocene onwards. *Myoxus glis*, the Garden Dormouse, has been identified with some doubt from the caves of Lunel Viel; and this is also probably the species occurring in the Belgian bone-caves, and described as *Myoxus priscus* by Dr. Schmerling. A species a little larger than the Dormouse occurs in Russian caves, and has received the name of *Myoxus fossilis* from M. Fischer; and the most striking species of all is also a Post-Pliocene form, namely, the gigantic Dormouse of Malta (*M. melitensis*). This animal, which seems to have been about the size of a

Guinea-pig, must have been excessively abundant in Malta, for its describer, Professor Leith Adams, says that "its remains are met with in abundance throughout the cavern and fissure deposits, up even to the superficial alluvium now in course of formation." From older times we have evidence of the existence of a Dormouse, about the size of the common species, at the time of the deposition of the gypsum of Montmartre (Upper Eocene), in which a well-preserved skeleton of the animal has been found. The same deposit has furnished traces of a second rather larger species. The Miocene of Switzerland and of Sansan has also yielded species of *Myoxus;* and Professor Hermann von Meyer has recorded a Dormouse from the Miocene of Weisenau, under the name of *Brachymys ornatus*.

No fossil LOPHIOMYIDÆ have yet been detected, but the great family MURIDÆ has left abundant evidence of its former existence. Species of the genera *Mus*, *Arvicola*, *Myodes*, and *Cricetus*, identical in many cases with those now living, have been obtained frequently in Post-Pliocene deposits and in bone-caves in Europe. Lemmings (*Myodes lemmus* and *torquatus*) are recorded from English caves. The genus *Mus* is also represented by several species in the Miocene deposits of France, and in the Sivalik beds investigated by Falconer and Cautley. The Miocene of Sansan has furnished a form which has been doubtfully regarded as a Gerbille, and named *Meriones Laurillardi*. In the same and other deposits of the same age in South-eastern France several species of an extinct genus (*Cricetodon*) have been obtained. Their dentition resembles that of the Hamster, but the first molars in both jaws have a tubercle less; the largest species (*C. sansaniensis*) rather exceeded the Hamster in size, while the smallest was less than a Mouse. Associated with some of these are two doubtful forms, *Decticus* and *Elomys*, the latter considered by M. Aymard, its describer, to be allied to *Hydromys*. The American fossil Muridæ are for the most part either species of the genus *Hesperomys*, or nearly related to it. Twelve species of that genus were obtained by Dr. Lund from the Brazilian bone-caves, but of these eight were identified by him with species still existing. In North America two species of a nearly-allied genus (*Eumys*) have been obtained from Miocene deposits; and the bone-caves of Pennsylvania furnish the remains of a species of *Neotoma* (*N. magister*), hardly distinguishable from the Florida Rat.

A *Rhizomys* from the Sivalik deposits of North-western India is the only recorded fossil representative of the SPALACIDÆ; and of the GEOMYIDÆ the only known species are a *Geomys* from the Pliocene of Nebraska, nearly allied to, if not identical with, the living *G. bursarius;* and one from the "Tertiaries of the Plains," described by Professor Cope as *Colotaxis cristatus*, which, however, has only three molars in the lower jaw.

The DIPODIDÆ are still more scantily represented. A Jerboa described by M. Fischer from Post-Pliocene deposits, probably of Tartary, is very nearly allied to the living *Dipus platurus*, but has shorter toes and broader cannon-bones. The genus *Dipoïdes*, from the "Bohnerz" of Würtemberg, is founded on a single tooth, and its position in this family is very doubtful.

On the other hand, some fossil allies of the Dipodidæ and Geomyidæ constitute a distinct family, for which Mr. Alston proposed the name of THERIDOMYIDÆ, from that of one of its genera, *Theridomys*. In this genus, of which six species are recorded from the Eocene and Miocene deposits of France, there are four rooted molars in each series, and each of these has several enamel folds, some of which are converted into isolated loops as the crown is worn away. The best known species is *Theridomys platiceps*, from the Miocene of Caylus. In *Archæomys chinchilloides* there are still four molars, but these present a very different structure; they are rootless, and have the enamel folds extending diagonally across the crown, so that they are composed of a series of plates, thus presenting a certain amount of resemblance to the Chinchillas, which American family *Archæomys* was at one time supposed to represent in Europe. In fact, in the structure of their molar teeth, both the above genera approach American types; but in other characters, especially the form of the lower jaw, they appear to have been decidedly Mouse-like, and Mr. Alston regards them as most nearly related to the Dipodidæ, with which they are joined by a third form referred to the family *Issiodoromys*, a genus sometimes placed with the Jerboas. The teeth in this genus are of the same number as in the preceding, but the molars are much simpler, each of them exhibiting one large re-entering fold of enamel, which causes the surface of the tooth to present two heart-shaped lobes. This structure is not dissimilar to that prevailing in some Dipodidæ, and especially in *Pedetes*, but it was formerly thought to indicate a relationship to the Cavies, and accordingly the best-known species has received the name of *Issiodoromys pseudanæma* (*Anæma* being a sub-genus of Cavies).

This species occurs abundantly in the Miocene lacustrine limestone near Issoire. A second species (*I. minor*) has been detected in the Upper Eocene of Lamandine-haute.

Of the Octodontidæ, an essentially American family at the present day, nearly all the recorded fossil forms are also American. Species of *Echinomys*, *Loncheres*, and *Phyllomys* were obtained by Dr. Lund from the Brazilian bone-caves, which also furnished him with the remains of a Coypu (*Myopotamus antiquus*), and of an allied form, *Carterodon sulcidens*, distinguished by its having broad incisors with longitudinal furrows and raised ridges. The latter has since been found living in South America. Another species, allied to *Echinomys*, is named by Lund *Lonchophorus fossilis*. The superficial deposits of South America have yielded the remains of two species of *Ctenomys*, one of which is believed to be identical with a recent species. As several species of this family now live in Africa, the occurrence in the eastern hemisphere of fossil forms belonging to it would not be surprising, but the few that have been referred to it are of very doubtful nature. M. Lartet obtained some isolated teeth from the Miocene of Sansan, which he described under the name of *Myopotamus sansaniensis;* and one or two other types (*Adiacodon*, *Adelomys*), from Upper Eocene and Miocene beds, are of very uncertain position.

Of the Hystricidæ, or Porcupines, remains have been obtained in both hemispheres. In the Old World traces of true Porcupines (*Hystrix*) are recorded from the Valley of the Arno, from the Sivaliks, the Pliocene deposits of the Auvergne, from Pikermi, and, on very doubtful evidence, from the Upper Eocene of Lamandine-basse; whilst Dr. Leidy has described two teeth from the Pliocene deposits of Dakota, as belonging to a species (*Hystrix venustus*) allied to the European Porcupine. This determination, if confirmed, would be of great interest, as no true Porcupine now occurs in America. Of the American type, two species of *Sphingurus* have been obtained from the Brazilian bone-caves; and Professor Cope records a species of the North American genus *Erythizon* from a similar cave in Pennsylvania.

The Chinchillidæ have left but scanty traces of their former existence. *Lagostomus brasiliensis* is from the Brazilian bone-caves; and *Megamys patagoniensis* from the Eocene sandstone of Patagonia. The latter species is founded upon a tibia and rotula, which on comparison seemed to approach most nearly to those of the Rodents of this family, and if the determination be correct it was probably one of the largest species of the order, as the tibia measures about a foot long. *Amblyrhiza* and *Loxomylus*, are two genera described by Professor Cope from bone-caves in Anguilla Island, West Indies.

The Dasyproctidæ have but few fossil representatives, and the undoubted ones are all from the bone-caves of Brazil, which furnished Dr. Lund with two Agoutis and two Pacas. Of the former, one is described as *Dasyprocta capreolus;* the second is allied to the living *D. caudata*. The two species of *Coelogenys* are extinct. Some teeth, found in Tertiary deposits of the Puy-de-Dôme, have been referred to *Dasyprocta*, but this determination is excessively doubtful. *Diobroticus schmerlingi* from Belgian caves has been placed with the Castoridæ.

Of the Caviidæ, Dr. Lund obtained three species of the genus *Cavia*, and two of *Hydrochærus*, from Brazilian bone-caves. Of the latter, one was allied to the existing Capybara; the other was a gigantic species, measuring about five feet in length. Dr. Leidy has described a species (*Hydrochærus æsopi*) from teeth found in Post-Pliocene deposits in South Carolina; and the Pampean deposits of the same age furnished M. D'Orbigny with the remains of a Cavy (*Cavia antiqua*) which, however, is doubtfully distinct from the Patagonian species.

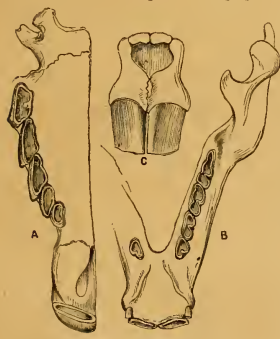
The remains of species of the family Leporidæ are very abundant in some Post-Pliocene cave deposits on both sides of the Atlantic, and in several cases the species are evidently identical with those now living. Besides these, species of the genus *Lepus* have been found in Pliocene and Miocene beds in France. In North America three extinct Leporine genera have been recognised, differing from *Lepus* in certain peculiarities of the molar teeth:—*Palæolagus*, with three species, from the Miocene of Dakota and Colorado; *Panolax*, from the Pliocene marls of Santa Fé; and *Praotherium*, from a bone-cave in Pennsylvania. The last-named genus has the crowns of the molars transversely oval, and without the enamel-band or crest which is seen on the surface of the teeth of other Hares.

The Lagomyidæ are known in a fossil state chiefly from Post-Pliocene deposits, and the bone breccias of caves in various parts of Europe. In Post-Pliocene times the genus *Lagomys* seems to have been very generally distributed over the South of Europe; and the earliest appearance of the genus

is in the Pliocene, three species having been described from deposits of that age at Œningen and Montpellier. The family is, however, carried further back in time by the genus *Titanomys*, in which the molars differ but slightly in structure from those of *Lagomys*, but there are only four of them in each series, both above and below. Two species of this genus have been recorded from Miocene deposits in France and Germany.

We have thus passed very briefly in review the fossil Rodents belonging to the two great sections of the order to which all its living species are to be referred; and it will be seen that while a knowledge of their existence is necessary to complete the history of the order, they present none of those peculiar characters which lend such interest to the fossil members of many other orders. There is, however, one fossil South American type to which we have yet to refer, as, by the curious combination of characters which it presents, it has long been somewhat of a puzzle to palæontologists, and although generally placed among the Rodents, its peculiarities are such that Mr. Alston found himself compelled to establish a third primary section of the order for its reception. According to M. Bravard, the first discoverer of this peculiar type, the Pliocene deposits of the Pampas of La Plata contain the remains of three species belonging to it; but the bones which have been sent to Europe, and which represent most parts of the skeleton, seem all to belong to a single species, which has been very fully described by M. Serres under the name of *Mesotherium cristatum*.* What distinguishes it at once from all other known Rodents is the presence *in the lower jaw* of four incisor teeth, the second pair being very small and placed immediately behind the outer edge of the broad middle pair. The latter are peculiarly widened and compressed from front to back in both jaws, and their summits, instead of being worn to a sharp chisel-like edge as in ordinary Rodents, show an elongated ring of enamel surrounding a slightly depressed surface. Hence Mr. Alston denominated this section HEBETIDENTATA, or BLUNT-TOOTHED RODENTS. The enamel in all the incisors is continuous round the tooth. The molar teeth are rootless and curved, the convex side being directed outwards, contrary to what occurs in other Rodents. They are surrounded by enamel, and show re-entering folds which differ in the two jaws. Their number on each side is five in the upper and four in the lower jaw. The skull is massive, with enormously-developed sagittal and occipital crests, the latter of which run forward so far as to join the zygomatic arches; and these crests rise so high that the upper surface of the actual brain-case is entirely concealed by them

SIDE VIEW OF SKULL AND LOWER JAW OF MESOTHERIUM CRISTATUM.



DENTITION OF MESOTHERIUM CRISTATUM.
(A) Upper Jaw: (B) Lower Jaw; (C) Incisors.

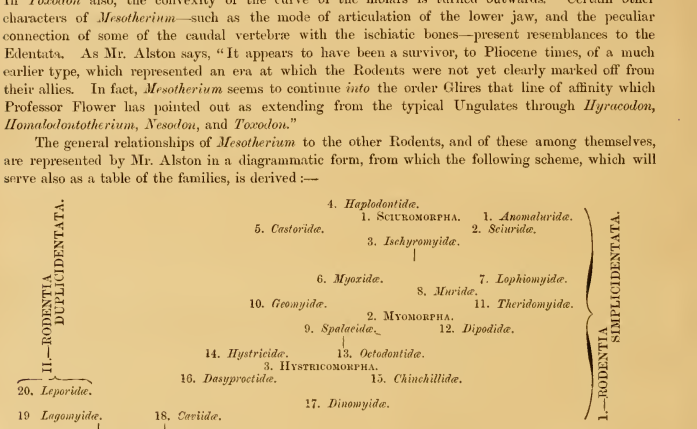
* Described almost at the same time by M. Bravard under the name of *Typotherium*. We here employ M. Serres' name.

when the skull is looked at from the side. The lower jaw in its characters presents some resemblance to the same part in the Leporidæ; but it has the condyle for its articulation with the skull transverse, and fitting into a cavity of corresponding direction, a character which occurs in no other Rodent. Of the remainder of the skeleton we need only state that the animal possessed perfect clavicles; that the shoulder-blade and humerus somewhat resemble those of the Beaver; that the fibula articulated with the heel-bone; and that both front and hind limbs possessed five toes, some of which, judging from the form of the terminal joint, were probably furnished with hoof-like claws.

Thus, as regards its affinities in the order Rodentia, *Mesotherium* presents resemblances in its lower jaw (as also in some peculiarities of the skull), and in the articulation of the heel with the shank, to the Hares; while in the shortness of the incisors and some other cranial peculiarities, the form of the shoulder-blades, and the probably hoof-like character of the claws, we may notice an approach to the Cavies, which are also South American forms, and especially to the Capybara, which it probably resembled in its habits, although, if the evidence of the Beaver-like shoulder-blade and humerus be taken into account, it would appear to have been still more aquatic.

On the other hand, the resemblance to certain other Mammalia, and especially to some aberrant Ungulates, is unmistakable. The number of incisor teeth is the same as in *Hyrax*, and in these teeth there is also a certain amount of resemblance to the curious genus *Toxodon*, in which the incisors are four in the upper and six in the lower jaw, and worn away in somewhat the same fashion. In *Toxodon* also, the convexity of the curve of the molars is turned outwards. Certain other characters of *Mesotherium*—such as the mode of articulation of the lower jaw, and the peculiar connection of some of the caudal vertebræ with the ischiatic bones—present resemblances to the Edentata. As Mr. Alston says, "It appears to have been a survivor, to Pliocene times, of a much earlier type, which represented an era at which the Rodents were not yet clearly marked off from their allies. In fact, *Mesotherium* seems to continue *into* the order Glires that line of affinity which Professor Flower has pointed out as extending from the typical Ungulates through *Hyracodon*, *Homalodontotherium*, *Nesodon*, and *Toxodon*."

The general relationships of *Mesotherium* to the other Rodents, and of these among themselves, are represented by Mr. Alston in a diagrammatic form, from which the following scheme, which will serve also as a table of the families, is derived:—

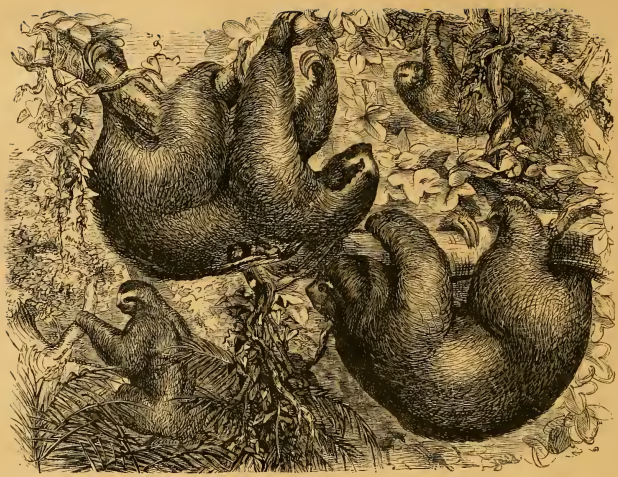


It seems quite clear, even from the above brief sketch of the history of the Rodentia in time, that, except in the case of *Mesotherium*, the fossil remains of animals belonging to this order furnish us with no important information bearing upon their alliances and possible origin. They make their earliest appearances, so far as we know, in deposits of Eocene age; and the earliest forms the remains of which are sufficient to give us a clear insight into their nature, are manifestly members of families, and often nearly allied to species still extant in the regions where their traces are now found. Thus in Eocene and Miocene deposits, we have representatives of the families *Sciuridæ*, *Castoridæ*, *Myoxidæ*, *Muridæ*, *Geomyidæ*, *Chinchillidæ*, and *Leporidæ*, already differen-

tiated as at the present day, so far as the evidence goes; and it is clear that we must go much further back in time to seek the earliest appearance of the Rodent type, whether it branched off directly from the Marsupial series, or passed, as would seem to be indicated by *Mesotherium*, through a sequence of forms more or less related to the Ungulates.

Nor does the geographical distribution of the animals lead to any more definite conclusions. Certain families and even sub-families are of very wide range, the Muridæ and Sciuridæ especially being represented nearly all over the world, while the Hystricidæ and Leporidæ are also spread over very large areas, occurring in both hemispheres. Certain groups, such as the Sciuridæ of both sub-families, the Castoridæ, the Murine, and Arvicoline sub-families of Muridæ, the Leporidæ, and the Lagomyidæ, may be said to have a circumpolar distribution in the northern hemisphere, nearly allied and sometimes identical species being found in the more northern parts of both the Old and the New World, but mixed with other forms peculiar to the regions, especially as we advance southwards. On the other hand, the Myoxidæ are peculiar to the eastern hemisphere, as are also the Spalacidæ and the Dipodidæ (with the exception of *Zapus*, which is considered by Dr. Coues to form a distinct family), and all the sub-families of Muridæ, except those above mentioned as having a circumpolar range. The Myomorpha may in fact be looked upon as an Old World group, the Geomyidæ being the only exclusively American family; while the Hystricomorpha as a whole may be regarded as American, certain aberrant forms of the Octodontidæ inhabiting various parts of Africa and the Old World Porcupines being the sole representatives of that great section outside the western continent. Considering these facts, we may regard the Sciuromorpha and the Duplicidentata as originally polar types, or at all events as having an equal claim to an origin in the northern regions of either continent; while the Myomorpha, with their multitudinous forms spreading over all parts of the Old World, and having a much scantier representation in America, probably originated in the eastern hemisphere, and spread by a northern passage into the New World; and the Hystricomorpha would seem to have originated in South America, where they display the greatest variety of forms.

W. S. Dallas.



GROUP OF SLOTHS (*Arctopithecus griseus*).

ORDER EDENTATA, OR BRUTA (ANIMALS WITHOUT FRONT TEETH).

CHAPTER I.

TARDIGRADA, OR SLOTHS.

The South American Forests—Discovery of the Sloth—How it derived its Name—Peculiarities of Dentition—Food—Fore Limbs and Fingers—Hind Limbs and Heel—Other Modifications of Structure—Kinds of Sloth—Waterton's Captive Sloth—Habits of the Animal—Burchell's Tame Sloths—Manner of Climbing Trees—Disposition—Activity among Trees—Naturalists' Debate about Anatomy—Probable Conclusion regarding it—Skeleton—Vertebræ—the Rudimentary Tail—Most Distinctive Skeletal Characters—Arm, Wrist, Hand, Fingers, Claws—Mode of Walking—Great Utility of the Claws—Face of Sloth—Skull—Teeth—Classification—*TARDIGRADA*—BRADIPODIDÆ—Genus BRADYPUS—Characteristics—Genus ARCTOPITHECUS—Characteristics—CHOLŒPODIDÆ—THE COLLARED SLOTH—Description—Skull Bones—Habits—Circulation of the Blood—*Rete Mirabile*—THE AI—THE UNAU—Appearance—Skull and Teeth—Skeleton—Interesting Anatomical Features—Stomach—HOFFMANN'S SLOTH—Description—Habits.

WHEN the dense forests of the northern parts of South America were first explored by Europeans, it was observed that active Spider Monkeys, Howlers, and their Quadrumanous allies, were not the only climbing animals which frequented the trees. For every now and then, hunters came in sight of creatures about the size of a large Monkey, but whose sluggish movements, long hair, short heads, small ears and tail, and very long claws, enabled them to be distinguished at once from their very lively companions. It was noticed that these new creatures, instead of climbing quickly and swinging from branch to branch and running along the boughs, moved very slowly, by hanging head and body downwards and grasping the branches with their long claws. During the daytime, these quiet animals were constantly found asleep, huddled up in the fork of a branch, and looking like great balls of tow, or else hanging by two legs, the rest of the body being curled up. Now and then, one was seen at the foot of a tree, and it appeared to run along the ground with great difficulty; for the arms were so long that it walked on the elbows, and the hind feet were turned in, so

that it supported itself on the sides of its great hind claws. Naturally, the animal took its time in moving, and as it was never seen to be lively, it received the name of Sloth. Interesting from being so different in its habits from other arboreal animals, it became much more so, to naturalists, when its remarkable construction was ascertained; but still the hairy creature with a short face, small head, long neck, hardly any tail, and very long front limbs, retained its popular name.

A very slight examination of one of the Sloths showed that it had no front teeth, that is to say, neither incisors nor true canine teeth, and that the hinder teeth—the false and true molars—were not like those of any other mammal. The back teeth, few in number, have since been ascertained to be exceptionally simple in their structure, and evidently the masticating process is very simple. But when it was noticed that the Sloth fed upon leaves and young twigs, the absence of the necessity for more elaborate teeth was acknowledged. Then it was observed that they had very long arms, or rather fore limbs, for the fore-arm bones and the humerus are all unusually long, and also that they had great power of movement. Moreover, it was seen that the fingers were reduced to three in number in some kinds, and to two in others, and that they were furnished with long and strong claws, which did not interfere with a great amount of mobility in the wrist. The length of limb, the mobility of the wrist, and the great claws, enable the Sloth to bring the leaves to its mouth, to hang on, and to walk, as it were, beneath the branches. An examination of the hind limbs showed that they were shorter than the others, and always furnished, in all kinds of Sloths, with three great claws. But the ankle seemed to be turned in, as if there was a state of "club-foot." This condition would enable the toes to clasp a bough without effort, but it would prevent the sole from being placed flat on the ground. As the knowledge of the anatomy of these constant tree-livers progressed, other modifications of structure, equally important in relation to the peculiar arboreal life and food, were gradually discovered. For instance, a remarkable flexibility of the neck, produced by the peculiar arrangement of the vertebræ; a *rete mirabile*, to a certain extent, in the limbs, resembling somewhat that in the Lemurs (Vol. I., pages 213, 245), and a complicated stomach suited for the digestion of leaves, and foreshadowing that of the Ruminants.

Two different kinds of Sloths were described in the first instance, and subsequently, several others. The first kinds known were the Ai, a Sloth with three claws on the fore limb, and the Two-toed Sloth, with two claws on the fore limb. The Ai was called *Bradypus tridactylus*, and the other the Unau, or *Bradypus didactylus*, names which have been changed somewhat, as will be seen further on.

Sloths are caught without much difficulty, and their habits, in captivity, have been observed in South America, and also after their removal to Europe. Waterton writes * on the subject:—

"Some years ago I kept a Sloth for several months. I often took him out of the house and placed him on the ground, in order to have an opportunity of observing his motions. If the ground were rough he would pull himself forward by means of his fore-legs, at a pretty good pace, and he invariably shaped his course towards the nearest tree; but if I put him upon a smooth and well-trodden part of the road, he appeared to be in trouble and distress. His favourite abode was the back of a chair, and often getting all his legs in a line upon the topmost part of it, he would hang there for hours together. The Sloth, in its wild state, spends its whole life upon trees, not upon the branches, but under them; he moves suspended from the branch, he rests suspended from it, and he sleeps suspended from it; hence his seemingly bungled conformation is at once accounted for. One day, crossing the Essequibo, I saw a large Two-toed Sloth on the ground upon the bank, and although the trees were not twenty yards from him, he could not make his way through the sand in time enough to make his escape before we landed. He threw himself on his back and defended himself with his fore-legs. I took a long stick and held it for him to hook on, and then conveyed him to a high and stately Mora. He ascended with wonderful rapidity, and in about a minute he was almost at the top of the tree. He now went off in a side direction, and caught hold of the branch of a neighbouring tree, and then proceeded towards the heart of the forest."

At Santos, in Brazil, in 1826, Mr. Burchell kept a tame Sloth, a *Bradypus tridactylus*, which at the end of two months pined and died. It fed exclusively on the buds and leaves of a species of *Cecropia*, a tree having a slender stem of thirty or forty feet long, with horizontal branches, hollow internally:

* Waterton's "Wanderings," pp. 161, 284.

and naked, except at the extremities. It ate only the young shoots and terminal buds of the unexpanded leaves, rejecting the old leaves on the boughs, which were brought to it daily. It was always perfectly silent, and its countenance and manners were most expressive of melancholy. It fed by day, and slept much; being kept in a room, it sat upright upon its short tail, embracing the legs of a chair with its arms and legs.

When resident at Para, near the mouth of the Amazons, Mr. Burchell also kept two full-grown Sloths, and a young one of a three-toed species (not *Bradypus tridactylus*, but of nearly similar form and habits), in a garden enclosed with strong stockades. They were kept tied up to the pillars of a verandah, to prevent their escape. Against these pillars they always placed themselves in an erect position, embracing the pillar with all four legs; when not tied to the verandah, they got up into trees in the garden. They slept both by day and night, always fixing their arms round something or other. Their food, consisting of branches, was brought to them in the verandah. They appeared extremely stupid, and would never come to the food. They would eat no leaves but those of the *Cecropia*.

They did not mount very large trees, and they ascended with their breasts pressing the trunk of the tree, advancing the hind-leg beyond the fore-leg. On the ground, they could neither stand nor walk, but lay sprawling on their belly, and dragged, or rather warped, themselves along, laying hold of a bunch of grass or stone with their three claws, which operated like grappling-irons, or, rather, pincers. All these died in a month or two. In their wild state they are seldom seen, from their colour mingling with the grey foliage of the trees, and from their being so extremely quiet and slow. The tame Sloths never willingly remained on the ground, except to pass from one tree to another. All the movements of the animal are slow. It moves its claws slowly. In eating it chews slowly; it also climbs slowly. The moisture of the leaves it eats suffices it for drink, without descending to obtain water. None of those kept by Mr. Burchell were ever seen to drink. The full-grown animals were never heard to utter any sound, but the young one occasionally, though rarely, gave a short cry or whistling squeak, of a single note.

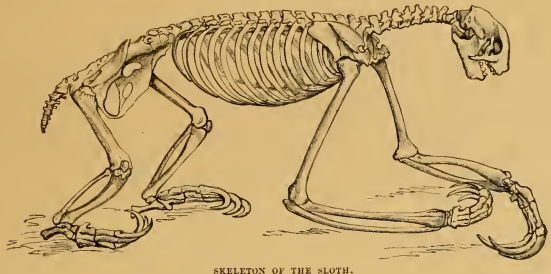
They showed no indication of fear, and seemed to give attention only with their eyes. They took no notice of the boy who often carried them across the garden to their place in the verandah, with their long arms sprawling; the only objects of their regard were trees. They fight on their backs, and grapple their enemy to strangulation. The use of the long wool that covers the body, and even the face, seems to be to guard them from the annoyance of insects. Possibly it may preserve them from the attacks of Snakes, which are, doubtless, their greatest enemies.

The Sloth spends nearly the whole of its life in the trees, and travels along the branches body downwards. It rarely comes to the ground, on which it walks with difficulty, and it occasionally takes to the water and swims. It looks slothful enough when asleep, for it then resembles a bunch of rough hair, and a jumble of limbs close together, hanging to a branch; but when awake, it is industrious in its search for nice twigs and leaves, and moves along the under side of the branches of the trees with some activity. It seizes the ends of adjoining branches, clinging to the leafy mass, and moves from tree to tree quickly enough, when it is requisite, and it has a very singular power of moving the head and neck backwards in seeking food. When the atmosphere is still, the Sloth keeps to its tree, feeding on the leaves and twigs, but when there is wind, and the branches of neighbouring trees come in contact, the opportunity is seized, and the animal moves along the forest, under the shady cover of the boughs. The Indians have a saying that "when the wind blows the Sloths begin to crawl," and the reason is thus evident enough—the animal cannot jump, but it can hang, swing, and crawl suspended. Mr. Waterton states, however, that "the Sloth travels at a good round pace, and were you to see him passing from tree to tree you would never think of calling him a Sloth. Being born up in a tree, living amongst the branches, feeding on leaves, and finally dying amidst the foliage, and enjoying life as much as any other animal, its structure and conformation are, of course, admirably suited for this arboreal existence. Its power of grasp is great, and is assisted by the great bent claws as it hangs by its feet when asleep, and also often when it is dead. One which was much frightened by being taken from the forest had a pole placed near it at a little distance from the ground, on two supports. It clung directly to the pole and hung on. A Dog was then made to attack the Sloth, which seized it in its long claws, and did not let go until the enemy died."

Leading thus a very unusual kind of life, up amongst the dense foliage, and having some very unusual peculiarities of construction, much debate occurred many years since regarding the general conformation as well as the special anatomy of the Sloths. One school of anatomists considered the Sloths incomplete and abnormal animals, moving with "pain" on the ground, and another regarded their unusual and peculiar anatomy as singularly beneficent.

But whilst it is perfectly evident that the long limbs and their joints, and the peculiar turning in of the ankles, and the structure of the clawed hands and feet, are all admirably adapted for the peculiar life which the animal leads, it appears to be consistent with anatomical reasoning to believe that the Sloth is an instance of retrograde development; that, in fact, the peculiar formation of the skull, neck, wrists, and ankles, is the result of the laws of disuse and adaptation operating on ancestral animals, which once had their anatomy more consistent with a perfect mammalian type.

When the Sloths were first carefully watched and studied, their length of neck and their ability to turn the head, so as to look at a person standing directly behind or beneath them, without swerving the body, struck Mr. Burchell especially. This curious peculiarity led to a careful examination of the skeleton of the different kinds, and much discussion followed, for it was found that in the Sloth



SKELETON OF THE SLOTH.

examined (the Three-clawed Ai) there were more neck bones (vertebræ of the cervical region) than in other Mammalia. Instead of the common number of seven neck bones, there were nine. This elongation of the neck of course permitted a greater amount of twisting than could occur in an animal with fewer neck bones. But there are other reasons why the head can be so much twisted round, for the spines on the neck bones are small, and the joint between the skull and the first vertebra is so fashioned that this remarkable motion is possible. There was a great deal of discussion about the extra neck bones, and as the last two had rib-like projections from their sides, some anatomists considered them to belong to the true rib-bearing vertebræ, or those of the back (the dorsal). But when the other Sloths were examined it was found that the number of the bones of the neck in all the two-fingered kinds was not as great as in other animals. There are only six neck vertebræ in one well-known species (*Choloepus Hoffmanni*, for instance), whilst there are seven in another two-toed Sloth.

Eating largely and of bulky substances, the Sloths require a large digestive cavity, and the ribs are numerous, and the body is long and broad. There is much variation, however, in the number of the back bones in the dorsal and lumbar regions. Thus in the Ai there are sixteen dorsal and three lumbar vertebræ, whilst in the Two-fingered Sloth there may be twenty-three or twenty-four dorsal bones, and two, three, or four lumbar vertebræ. The ribs are close together and are broad. As the hind limbs require strong muscles, for the animal hangs on by them whilst it is feeding itself with the fore hands, the pelvis is large and is strengthened by having the hip and haunch bones (ilia and ischia) united to the conjoined sacral vertebræ, which may be six, seven, or eight in number. Moreover, all the strength of the pelvis is behind, the fore part or pubic bones being slender and united in front.

Some small tail bones exist, for that organ is rudimentary in all the Sloths, there being a stump in the Ai, and eleven very small bones; but in the Two-fingered Sloths the tail is not visible, and there are four little ossicles. There are no long and very prominent spines to any of the back bones, and the whole bony column of the spine is readily curved and bent. The animals so constantly bring the hands and feet close together, when hanging, that a ready bending of the spine is absolutely necessary. Moreover, in sleeping they often rest in the fork of a tree, or on a branch, and place the head between the hind legs, rolling the body up as it were in a ball, and this is facilitated by the peculiar construction of the long chain of back bones with small spines.

The most distinctive character of the skeleton of the Sloth is the excess of length of the fore limb over the hind one. An examination of the slender bones of the arm shows that they are more solid than those of most Mammals. The arm bone (humerus) has a hole through it in the inner expanded part, just above the elbow (inner condyle), in the Ai; but this is not found in the two-toed kinds. The wrist and hand are long and narrow, and this is produced by the union of some bones which are separate in other Mammalia, and the slight development of others. Thus there are six bones in the wrist instead of eight (the scaphoid and trapezium, and the os magnum and trapezoid have coalesced). In the Ai there are three clawed fingers, and the bones of the thumb and of the little finger are absent, and their corresponding hand bones (metacarpals) are very small, and are joined on to the next, that is, to the metacarpal of the index and third finger.

BONES OF HAND OF THREE-TOED SLOTH.

The three fingers are, moreover, strengthened for their peculiar uses, the first two joints being united, and the tip or last joint being very long, and supporting the claw. Moreover, as the long claws are constantly half closed in the hand, and they are never required to be widely open, the tip of the finger is so made that flexion is possible, but not unclasping widely. The skin comes up to the base of the claws, and encloses the fingers, and the base of each claw is protected by a bony sheath. They form capital hooks; they grasp, and although there is no opposable thumb, they hold the food; and a tame Sloth may be seen holding a carrot very firmly between them and the wrist. In the case of the Unau Sloth, the outer claw is the longer.

The Sloths walk on the outside of the extremities of the fore and hind limbs, and their claws are always curved in, and, as it were, retracted. Consequently, the animal cannot place the soles flat on the ground, and it cannot open its foot-claws to a great extent. This fixing of the claws assists in the clasping and hanging, which are the usual and commonest attitudes. The claws surpass the foot in length, and are so sharp and crooked that they readily seize upon the smallest inequalities in the bark of the trees and branches upon which the animals habitually reside. They and those of the fore limb are no mean weapons of offence and defence, for, situated at the end of long and muscular arms, they can drag, cling, and hold with great tenacity. The thigh bone (femur) of the Sloth is straight, and is thicker and shorter than the arm bone (humerus); it has no ligament to unite it to the joint (no ligamentum teres). On examining the lower bones of the leg (the tibia and fibula), they will be found to be bent, so as to leave a space between them, and they are shorter than the bones of the fore arm. The bones of the ankle joint, are united together immovably—that is to say, the usual bones seen in other Mammalia are there, but are united by bone. Moreover, this union includes the complete and ill-developed feet bones (metatarsals), and the first bones of the second, third, and fourth fingers. One bone is not included in this strange union. It is the astragalus, or the bone immediately jointed with the ends of the bones of the legs. The outer or small bone of the leg (fibula) fits into a pit in the outer part of the upper surface of this bone, and thus prevents any movement of the foot like a twisting outwards, and favours, but does not produce, the usual position of twisting inwards. Moreover, there are two powerful muscles in the front of the leg which are not opposed by others as strong, and they, by their contraction, keep the foot twisted inwards, as in club-foot (the anterior tibial and the long extensor of the great toe).

In the Unau, or Two-fingered Sloth, there is the same general arrangement of the bones and

muscles, with some important differences, which result in there being a greater amount of bending and extending of the foot, although the foot rests on its outer edge.

A Sloth's face is short, and there is a broad snub nose, with round nostrils, which are widely open. The cheeks become wide suddenly, and the forehead slopes rapidly backwards, the eyes being wide apart and small, but looking forwards. The head is small and round, and as it is covered with hair behind, it cannot be distinguished well from the upper part of the back of the neck. The expression of the face is always the same, and the method of masticating and eating is disagreeable to observe. The animal having no front teeth, and moving its jaws usually only upwards and downwards, and not from side to side, places the morsel, such as lettuce leaf or carrot, well into its mouth, and chews at it, dragging out the food every now and then, when it is covered with moisture. On examining the skull, the short cut off or truncated appearance of the face is very evident, and it will be observed that the teeth are wanting in the front bones of the face (the pre-maxillaries), and that only the palatal part of these bones exists. The lower jaw is strongly jointed to the upper, and the back part is large: there are teeth at the sides, but there are none in the front part of it. A very singular-looking cheek bone (zygoma) exists on either side. It is not attached behind to the ear bone, so as to cover the jaw muscles, but it has two processes behind—an upper and a lower—which differ in shape and size according to the species. The central bone of the nose does not reach to the nasal outlet, and there is a system of air-cavities which is continued from the nose into the forehead bone. In some kinds, the lower jaw ends abruptly in front, as in the Ai; but in the Unau Sloths it is slightly angular, and projects.

SKULL OF SLOTH.*
(From the *Proceedings of the Zoological Society.*)

The back teeth of the Sloths are very simple, and consist of three structures, called vaso-dentine, hard dentine, and cement, there being no proper enamel. The vaso-dentine is a kind of bony substance in the centre of the tooth, in which there are the passages and tubes of blood-vessels. The dentine is outside this, and consists of more earthy particles than the vaso-dentine, and of fewer tubes; it is all the denser and more resistant. Wearing away more slowly than the vaso-dentine, it forms a ridge which grinds easily. The cement is a kind of bony structure on the outside of the tooth. The teeth of the Sloth continue to grow from below as they are worn above, and there is no entire milk set which are replaced by those of a permanent kind.

The term Sloth is commonly applied to all the kinds of animals whose general shape and habits have just been noticed. It is evident, however, that this union of several species under one term is not correct in zoology, and it is necessary to distinguish them by peculiarities which are permanent. A very ready method of distinction is to separate the Sloths into two families, one containing those which have three claws on the fore limbs and the same number on the hind limbs, and the second including those which have only two claws on the fore feet and three on the hinder.

The first family is called the BRADYPODIDÆ, from *βραδύς* (slow), and *πούς* (foot), and the second CHOLŒPODIDÆ, from *χωλός* (halting, lame), and *πούς* (foot), and both are included in the group TARDIGRADA, or slow-moving *Edentata*.

The BRADYPODIDÆ include two genera, but many naturalists only acknowledge one. The first is *Bradypus*. This includes the Sloths with three-clawed fingers on the fore limbs, whose males and females are alike in their fur, and which have the cheek bone (malar bone) with two processes. The upper one is long and dilated at the end, and the lower is long and triangular, and neither of the processes reaches the ear bone. There are in these Sloths, when full grown, five molar teeth on each side in both jaws, and the first is very short. There are two mammæ on the chest.

* *Arctopithecus castaniceps.*

The second genus is *Arctopithecus* (Gray), and it contains species which have the males and females dissimilar in their colour and ornamentation, and the malar bone has a thin and narrow upper process.

The second family of the Sloths (the CHOLŒPODIDÆ) contains but one genus, *Cholœpus* (the Unau), whose species have two claws on the fore limbs and three on the hind ones. The front of the lower jaw is stuck out, and not cut short, and the first molar teeth are long.

The genus *Bradypus* probably contains several species, but it is only necessary to mention one, which is called

THE COLLARED SLOTH, OR THE HAIRY SLOTH.*

This Sloth lives in the densest forests of Brazil, Peru, and Para, and is found not far from Rio Janeiro.

It is a kind of the Three-clawed Sloths, in which there is little or no difference between the fur of the males and females. The neck is surrounded by a large collar of long black hair, and underneath this is a fur of a dark-brown colour. The face is naked, and is of a black colour, and the hair of the body is not very flattened, but is withered-looking to a certain extent. The forehead, temples, chin, throat, and breast are covered with reddish or rust-coloured hair, slightly grizzled. On the crown of the head it is long and yellow, and pale orange on the rest of the body. This Sloth produces one at a birth.

COLLARED SLOTH. (From Prince Maximilian of Neuwied's *Animals of Brazil.*)

The lower jaw has a kind of blunted lobe in front, and the angle of this jaw is broad, triangular, with a rounded lower edge, and it projects backwards beyond the joint which connects the bone with the skull. The cheek bone has those peculiarities which have already been mentioned. The teeth are peculiar, for the first or foremost grinders are smaller than the others, and the second upper grinder is the largest of all. The first grinder on the lower jaw is broader than the rest, and the hinder are the largest, being also cylindrical.

It has the general method of living of the Sloths, being perhaps not quite so lively or active as the Unau, and feeds mainly on *Cecropia* leaves, finishing those of one tree as far as it can before commencing those of another. Like all the Sloths, it has the power of long and sustained muscular action, and can cling on, or grasp, for a very long time without perceptible fatigue, and this gift is associated with a structure of the blood-vessels which supply the muscles, resembling, as we have said, that noticed in some of the Lemurs. The main artery which supplies each of the fore limbs is the axillary, so called from its being found in the armpit or

* *Bradypus torquatus*, or *Bradypus crinitus.*

axilla. In quickly-moving animals this vessel reaches into the upper arm, and divides into a few rather large ones lower down, and these give off others, so that a certain quantity of blood is supplied and removed quickly. But in the Sloths the axillary artery divides at once into a number of cylindrical vessels nearly as large as it is, and they are united here and there. These unusual arteries are found in contact with the surface of the muscles, and their branches go in and amongst the muscular bundles. As many as forty-two of these large vessels were counted by Sir A. Carlisle, on the surface of the muscles on the front of the arm, and probably about twenty were inside. These arteries thus carry an immense supply of blood to the muscles, but blood which, although it is finally removed by the veins, does not move very rapidly. In fact, the muscles are turgid with blood. The same arterial structure is seen in the hinder limbs, and the arteries of the thigh form as numerous a set as those of the arm.

AI. (From the *Proceedings of the Zoological Society.*)

It seems to be in accordance with careful investigation, to state that the species of Sloth called *Bradypus tridactylus* (the Three-toed Sloth, or Ai) has too large a meaning, and that it really refers to the Collared Sloth, as well as to others which have been placed in the next genus. It is as well to remark here, that although there are three clawed fingers to the fore limb, there are vestiges of two other ones by their side in the form of two rudimentary metacarpal bones.

GENUS ARCTOPITHECUS.—THE AI.*

Several kinds of three-clawed Sloths have been called Ai; for instance, the Yellow-throated Ai, and De Blainville's Ai, and all have been named *Bradypus tridactylus*. Dr. Gray, however, satisfied himself that the kind which was first described by Cuvier as the Ai, and which is figured in Prince Maximilian of Neuwied's "Animals of Brazil," is the same as one which has since been called *Arctopithecus Ai*, or *Arctopithecus flaccidus*. The word *Ai* is taken from the noise made by the animal, and the term *flaccidus* relates to its long hair. The true Ai inhabits Venezuela and Peru, and has very long flaccid grey hair mottled with white. There is an abundant under-fur of a blackish brown colour, which has white and black in spots and blotches.

* *Arctopithecus flaccidus.—Arctopithecus Ai.*

There is a small spot between the shoulders on the back, where the fur is soft and woolly, and a broad, short, blackish streak there, with a white or orange ring around it. The claws are coloured brown. The head has a curiously-cut short and turned-up nose appearance, and is furnished with coarse shaggy hair, disposed on the crown in a diverging manner. The short hair of the face contrasts with the long, shaggy, shrivelled, dry, hay-looking hair of the body. This hair is coarse and flattened at the ends, but it is exceptionally fine at the roots, and it greatly resembles in colour and texture some of the vegetation of the trees on which it lives. The eyes are bright, and are surrounded by a dark ring. Several species of the genus Arctopithecus have been described which live in Guiana, Bolivia, Brazil, Peru, and Venezuela.

SKULL OF AI.

The next genus of the Sloths is represented by

THE TWO-FINGERED SLOTH (THE UNAU).*

There are several kinds of Sloths with two "toes," or rather with two fingers ending in claws on the fore limb, but the differences between the species are not very readily appreciated. They are differences which can be recognised, but it is doubtful whether the possession of dark brown or pale brown hair is sufficient to decide that there are more than one species.

The common Unau Sloth is usually of a darker tint than the others, but there is no doubt that the specimens in museums of all these Sloths vary much in the colour and length of the hair. Thus the hair may be generally dark, and the hairs of the crest on the back of the head may be white, and more or less tinted with bright green; or the hair may be short, of a dark brown colour, paler on the rump, much paler on the head, cheeks, and chin; a band may be across the nose, and the orbits dark brown. Others of the same species have very long hair, of an uniform dark tint, paler on the head and redder beneath, whilst one from Juan de Fuca has short hair, without any indication of a crest. From Brazil there are specimens with long paler hair and a crest. All these specimens, however, have pale whitish claws.

A Unau from Columbia is of a pale and whitey-brown paper colour, darker at the root of the hairs, and it has pale fawn-coloured claws.

In all these animals with different kinds of furs, the two-clawed condition is peculiar to the fore limbs only, for on the hinder there are three claws, and it is to be remarked that the hair and skin unite the fingers and toes close up to the base of the claws. The skull of the Unau is rather projecting in front, and not, as it were, quite cut off close; and there is a great gap in the upper and lower gums in front, the incisor teeth being absent, of course. But at the side of the mouth there is a longish tooth above and below, looking like a canine, but really it is the front molar, which in both jaws and on both sides is longer and larger than the others. The under teeth belonging to the lower molar set are placed behind the corresponding upper ones when the mouth is shut.

The cheek or malar bone is seen, on looking at the skull, to be separated from the ear bone, and to have a forked end posteriorly, the lower part of the fork extending downwards and backwards.

The lower jaw is very straight: it projects a little, in front and behind, where it is jointed with the upper jaw, there is no upright portion or branch, or ascending ramus. The last back tooth is just in front of a curved piece of bone called the coronoid process, the base of which is on a level with the line of the teeth.

This Sloth has seven neck bones (cervical vertebræ), and the last one has a very small and rudimentary rib attached to it on either side. There are no less than twenty-three dorsal vertebræ found to be with ribs. The Unau has a clavicle which is much smaller in the other group. It has no tail. The structure of the ankle joint enables it to turn in, even more than that of the Three-clawed Sloth. As the habits of the Unau Sloth are the same as those with three claws, and all live in the same

* *Cholœpus didactylus.*

great district, these anatomical distinctions are very interesting, and relate to their remote ancestors, being hereditary legacies, which are of little or no importance in assisting the creature merely to live. One of the differences between the Sloths is singular. The Unaus have a very remarkably formed stomach, which may be said to be double. The first stomach is large and rounded, but it is contracted behind, and then formed into a kind of conical appendix. This appendix is doubled from left to right, and its cavity has a fold at its opening into the stomach. It forms a special part of the first stomach. Then it is to be noticed, that where the food enters the stomach, or at the opening, which is called the cardia, there is a pouch, looking like a bag at the end of the tube which runs down from the gullet to the stomach. This is the second part of the first stomach : and the third is a tube-like space which connects the cardia with the stomach far away to the left. These three cavities form the first stomach. The second stomach is of a slender form, and is very much smaller than the other. Its walls are thin for the first half of its length, but towards the spot where the gut commences (the pylorus) they are thick and muscular. A small fold occurs midway. There is a fold in the body of the smaller or second stomach, and there is a little hollow there with glands in it, and it is called the appendix to the second stomach.

STOMACH OF SLOTH.

The stomach is thus rather complicated, and its internal mucous membrane is so thrown into folds, and made into hollow spaces, that it occupies much more space than if it were a simple bag. This plan is also well seen in those ruminating animals which, like the Ox, live entirely upon vegetable substances ; and it is evident that the diet of the Sloth bears some relation to the complicated stomach.

In the Ai, the appendix to the second stomach is larger than that of the Unau Sloth, and is more complicated.

HOFFMANN'S SLOTH.*

This is a Sloth with two clawed fingers on the fore, and with three claws on the hinder extremities. Living specimens are occasionally brought to Europe, especially from Porto Rico, so that its general appearance may now and then be studied at the Zoological Gardens, in the Regent's Park. If it be looked at there in the day-time, it certainly merits the name of Sloth, for it resembles a bundle of long, light, brown hair, fixed on the top of a bar of wood close to an upright branch, or huddled up in a corner on the ground ; but in the morning, and also late in the evening, the creature begins to move slowly, and to look out for the food put for its use on the floor of the den. All the Hoffmann's Sloths have pale brown hair, whiter at the tips, and a white face, showing a brown band across the nose, extending to a ring round each eye. They have also a long and full crest of hair on the neck, and the hair on the limbs is darker than that of the rest of the animal. Dr. Peters, who discovered this Sloth, examined the skeleton, and found only six vertebræ in the neck, and in this it differs from the *Choloepus* just noticed.

When its food, consisting of carrots and lettuce, and bread-and-milk, is put down in the morning it is soon in movement, and enjoys its meal hanging down from a bar with its hind legs, and resting its back on the floor of the cage. It seizes the food between the claws and the long straight palm of the fore-foot, and passes it into its mouth, chewing actively with the molar teeth, especially with the first, which are sharp. It cares little for the spectators, and when it has finished, slowly mounts up into a corner of its little den and settles down to sleep. In the evening it becomes lively, for it is, and, indeed, all Sloths are, nocturnal in habit. The hairless snout, of a light red tint, the absence of "smellers," the little eyes with a few hairs around them, and the broad forehead, give the animal a curious appearance. The hair is brushed back on the forehead, and comes around the very small ears on to the cheeks, and is whitey-brown, and this same tint is seen over the whole of the back in long slender hairs. But the under hair is light red or red-brown. The long and

* *Choloepus Hoffmanni.*

slender hand, with its two claws, contrasts with the rather bulky upper part of the limbs, and the flesh-coloured palms are very remarkable.

The whole of the Sloths lead very monotonous lives; their food is ever within their reach, and it is abundant, and they do not appear to have to compete much or at all in the struggle for existence

HOFFMANN'S SLOTH.

with other animals. Their enemies are Snakes and the Carnivora, but it is evident that they are much more readily preserved by their habits from the latter than from the former. Leading such an uneventful existence, there is no great call upon their nervous energies or intelligence, and these are at a low pitch. The brain consequently is very simple in regard to convolutions, which are few in number and shallow.

CHAPTER II.

THE ANT-EATERS.

THE CAPE ANT-EATER—The Cage at "the Zoo."—Appearance of the Animal—Its Prey—The Ant-hills—How the Orycteropus obtains its Food—Place in the Order—Teeth—Skull—Tongue—Interesting Questions concerning the Ant-eater—THE PANGOLINS, OR SCALY ANT-EATERS—THE AFRICAN SCALY ANT-EATERS—Differences between the Pangolins and Cape Ant-eaters—Their Habitat—Description—TEMMINCK'S PANGOLIN—Habits—Food—How it Feeds—Superstitious Regard for it shown by the Natives—Scarcity—Appearance—THE LONG-TAILED, OR FOUR-FINGERED PANGOLIN—THE GREAT MANIS—THE ASIATIC SCALY ANT-EATERS—THE SHORT-TAILED, OR FIVE-FINGERED PANGOLIN—The Species of *Manis*—Skull—Stomach—Claws fitted for Digging—Other Skeletal Peculiarities—THE AMERICAN ANT-EATERS—General Appearance—Genera—THE GREAT ANT-BEAR Habits—Diet—How it Procures its Food—Distribution—Mode and Rate of Locomotion—Stupidity—Manner of Assault and Defence—Stories of its Contests with other Animals—Appearance—THE TAMANDUA—Description—Where Found—Habits—Odour—THE TWO-TOED ANT-EATER—Appearance—Two-clawed Hand—Habits—Von Sach's Account of his Specimen.

THE CAPE ANT-EATER.*—THE AARD-VARK.

IN one of the cages in the house, close to where the Kangaroos are kept, in the Zoological Gardens of London, there is usually a heap of straw to be seen and an empty dish. Outside the cage is placed the name of an animal, "The Cape Ant-eater." People look and wait, and as neither the animal nor the Ants it eats are to be seen, they go away, supposing that the absence of the last-named insects has caused the destruction of the animal, whose straw alone remains.

But in the evening, and sometimes in the morning, when the food is placed in the cage—not Ants, however—a long pair of stuck-up ears, looking like those of a gigantic Hare with a white skin and little fur, may be seen poked up above the straw; and, soon after, a long white muzzle, with small sharp eyes between it and the long ears, comes into view.

Then a very fat and rather short-bodied animal with a long head and short neck, low fore and large hind quarters, with a bowed back, comes forth, and finally a moderately long fleshy tail is seen. It is very pig-like in the look of its skin, which is light-coloured and has a few hairs on it. Moreover, the snout is somewhat like that of a Pig, but the mouth has a small opening only, and to make the difference between the animals decided, out comes a worm-shaped long tongue covered with mucus. The animal has to content itself with other fare than Ants in England, but it seems to thrive, and as it walks slowly on the flat of its feet and hands to its food, they are seen to be armed with very powerful claws.

In Southern Africa, whence this animal came, it is as rarely seen by ordinary observers as in England, for there it burrows into the earth with its claws, and makes an underground place to live in, and is nocturnal in its habits, sleeping by day.

The Orycteropus, which means digging-up foot, from ὀρύσσω (to dig up), and πούς (foot), is the deadly foe of the Ants of all kinds, and especially of those which, like the White Ants, live in large colonies and build nests.

These nest-building Ants abound in certain districts, but not in the region of the downs or karoos, nor where it is very dry and woody. They choose the country which is covered with a poor and so-called "sour" grass, and there they dig galleries in the ground, fetch earth from far and wide, and erect large rounded mounds of an elliptical figure, and often from three to seven feet in height. Apparently fond of company, the Ants congregate, and these gigantic hills of theirs are often crowded together and occupy the plains, as far as the eye can reach. The nests, or hills, are solidly built, and contain innumerable ants. This is the favourite resort of the Orycteropus, and the insects are his sole food then. Wherever ant-hills are found, there is a good chance of finding one of these Aard-varks, or Innagus, or Ant-Bears, as the Dutch and natives call them, leading a sort of mole-like life. But he is not easy to catch if the stories told be true. It is stated that the long strong flattened claws and short extremities, worked by their strong muscles, enable the animal to burrow in the soft soil as quickly as the hunters can dig, and that in a few minutes it will get out of the way; moreover, its strength is sufficient to resist the efforts of two or three men to drag it out of the hole. But when fairly caught, the Ant-eater does not resist much; it has no front teeth or eye teeth to do any harm with, and

* *Orycteropus capensis* (Geoffroy).

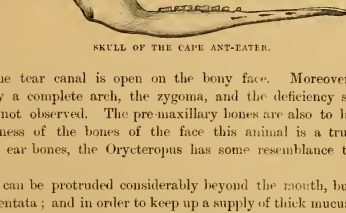
it can be killed easily by a blow on the head. The Ant-eater runs slowly, and never moves far from the entrance of its burrow, being seen to do so only at night-time. The burrows are often two feet in diameter and three or four feet deep before they branch off. Night is the time for Ant-eating, for the active and industrious insects are then all at home and within their solid nests. Then the Orycteropus sallies forth, finds a fresh nest, sprawls over it, and scratches a hole in its side, using his strong claws, and then introduces his long snout. Having satisfied himself that there is no danger at hand, the animal protrudes its long slimy tongue into the galleries and body of the nest, and it is at once covered with enraged Ants, which stick to it, and are finally returned with it into the mouth. This goes on over and over again, until the appetite is satisfied; and apparently the diet is excellent, for the Ant-eater is

CAPE ANT-EATER.

generally fat, and indeed his hams are appreciated as a delicacy for their peculiar flavour, into which that of formic acid is said to enter.

Although without an armour to its body, and provided with only a thick skin and bristles, the Orycteropus has a great resemblance in many points of its anatomy to the Armadillos of America. It is more closely allied to them than to the other Edentata. It is one of the order of Edentata, for there are no front teeth in the jaws, the incisors and canines being absent. The teeth are found in the back part of the mouth, and there are five on each side and in the upper and lower jaws, or twenty in all; there are also some small teeth which fall out during the growth of the animal. As might be expected from the very simple nature of the diet, the teeth are not at all complicated in their structure. They increase in size from before backwards, the last tooth but one being the largest, and all are peculiar in their minute construction. The first permanent tooth, which may be called a molar, is cylindrical in shape, and consists of a centre of very remarkable substance, for the body of the tooth is composed of a great number of vertical canals placed side by side, and running up the tooth. It was this interesting structure, so different to that of other animals, which led Cuvier to compare the teeth to pieces of cane. Outside this part of the tooth is a hard and more solid substance. When

the teeth are unworn, this outer covering covers their top, but as it wears off the tubular appearance is seen, and the ends of the tubes become exposed. The teeth have no fangs like those of such orders of Mammalia as the Carnivora and Insectivora, and they increase in length by growth from below, so that the wear above is continually compensated for. The second tooth resembles the first in its minute construction, but appears like two cylinders fixed together, a longitudinal groove indicating the junction, and this is the appearance presented by most of the others. The hindermost teeth resemble the first molars. The dental number varies according to age, and the presence or absence of the teeth which are not permanent. The jaws, in which the teeth are fixed, are long, and the lower one is low, but there is an ascending back part, or ramus; consequently, the face is long and low. The eye is placed far from the ear, and is small. Its bony case, or orbit, and its surrounding bones, are somewhat remarkable for an Edentate, for there is a lachrymal bone, and the tear canal is open on the bony face. Moreover, the malar bone is united to the ear bone by a complete arch, the zygoma, and the deficiency so remarkable in some other Edentates is thus not observed. The pre-maxillary bones are also to be seen, in front of the face. In this completeness of the bones of the face this animal is a true mammal, but in the nature and extent of the ear bones, the Orycteropus has some resemblance to reptiles and birds.



SKULL OF THE CAPE ANT-EATER.

The tongue is long, narrow, and flat, and can be protruded considerably beyond the mouth, but not so far as those of the other insect-eating Edentata; and in order to keep up a supply of thick mucus, the glands under and at its side, or the sub-maxillary, are very large and active in their functions. The stomach is moderately bulky and not simple, for the portion towards the right has very thick muscular walls, and the rest is thin. The intestine has a blind gut, or cæcum.* In fact, the stomach and blind gut might belong to an animal which eats something more bulky and less nutritious than Ants, and would be of use to the creature, did it eat vegetable matters. All these structures, the simple teeth, the tear bones, the size of the ear bones, the Sloth-like teeth, with tubes, however, and the peculiarities about the intestinal canal are, it must be remembered, associated with the life of a purely insectivorous animal. Why has it not the kind of teeth of the Insectivora and their stomach? and why should it combine high and low characters in its skull? These are questions which, when attempted to be answered, show that in the great philosophy of nature causes and effects are not everything, and that the same definite methods of life may be followed by animals very differently constituted.

The claws of the Orycteropus and the limbs are admirably suited for its kind of life. There are five claws on the hind limbs and four on the front, and they are long, slightly curved, flat, and scooped out below. The burrowing is facilitated by the arrangement of the claws as regards length, and they diminish in size from within outwards. There is a collar bone. The foot rests evenly on the ground and not on its outside, and the body is supported either by the whole foot or by the palm surface of the claws. The fore arm can be rotated more or less, and the pronator quadratus † muscle enables this necessary action to be carried out. The *Orycteropus capensis* lives over a wide extent of country in South Africa, in Caffraria, and in the western districts. A closely-allied species lives in Senegal (*Orycteropus senegalensis*, Less.); and a third is found in Southern Nubia, near the White Nile (*Orycteropus æthiopicus*, Sund.).

* The uterus is double, and the placenta is disc-shaped, and is cast off (deciduate). There are chest and inguinal teats. The vertebræ are—seven cervical, thirteen dorsal, eight lumbar, six sacral, twenty-five caudal.

† The muscle called pronator quadratus is a fleshy band, four-sided in shape more or less. One side is attached to one of the bones of the fore-arm, the ulna in front above the wrist; and the other and opposite side adheres to the radius. The ulna being motionless, the muscle contracts and pulls the radius over, so as to turn the back of the wrist forwards, or upwards. The prone position is thus produced, and hence the name of the muscle. The other muscle which produces this movement is fixed to the fore-arm in front, near the inner elbow, and it is long, having a tendon which is implanted on the radius. As this muscle contracts, it pulls the radius over the ulna, and makes the wrist take up a prone position. It is called the pronator teres.

THE PANGOLINS, OR SCALY ANT-EATERS.*

THE AFRICAN SCALY ANT-EATERS.

An animal living in the same country, on the same kind of food, and having many of the habits of the Cape Ant-eater, especially as it belongs to the same order of the animal kingdom, might be expected to resemble it in shape and in most of the important parts of its construction. But the comparison between the Ant-eater, just described, and the Scaly Ant-eater, shows that these animals have some very remarkable differences. The Scaly Ant-eater is toothless, and covered with scales.

Formerly, the Scaly Ant-eaters roamed far south in Africa, but now they are rare animals in South Africa, in the west of the continent, and across to Sennaar. They are found in Zanzibar, and as far south as the latitude of Mozambique. They are small animals, of from two to nearly five feet in length, with long tails; and their body, limbs, and tail are covered with numerous large, somewhat angular, and sharp-edged scales, as with armour. The scales overlap each other like

TEMMINCK'S PANGOLIN.

tiles, and the free part pointing backwards is bluntly angular or rounded at the tip. When the animal is on its feet walking, they form a very close and impenetrable covering, being doubtless of great use to the creature, for it must trust entirely to its defences, having no weapon of offence. But when the Scaly Ant-eater is alarmed or threatened with danger, or positively attacked, it rolls itself up like a ball, places the snout between the legs, and the tail underneath, and then sticks up its scales, offering their sharp edges to the enemy. There are several kinds of them, and one in particular was noticed by Dr. Smith, the African traveller, and was named after the zoologist Temminck, MANIS TEMMINCKII. He observed that it was rarely seen, but that when it was discovered, instead of burrowing, it did not attempt to escape, but rolled itself up instantly in the shape of a ball, taking especial care of its head, which is the only part unarmoured and likely to be injured. He states that Ants form its chief and favourite food, and that it secures them by extending its projectable tongue into holes which may exist in the habitations of those insects, or which it may itself form. The tongue having made an entry, it is soon covered with a multitude of insects, and as it is well lubricated with saliva, they are held fast, and when a full load is ready, the retracting muscles act on the tongue and the whole is carried back into the mouth, after which the Ants are swallowed. The same traveller accounts for the scarcity of the Scaly Ant-eaters, partly from the disinclination of the natives to discover them for strangers, and partly because they are environed with supernatural

* Genus *Manis*.

gifts in their eyes. They are carefully sought for, by the natives, for their own use and supposed advantage, for they believe the animal to have some influence on cattle, and that certain treatment to which they are exposed produces this. Whenever a specimen is secured by the natives, it is submitted to fire in some cattle-pen, apparently as a burnt offering for the increase of the health and fertility of all cattle which may henceforward enter the fold. "Here," writes Dr. Smith, "we have another cause for the obliteration of a species. Intolerance of their aggression has wrought up the shepherd or agriculturist to the destruction of some; but in this case, a species is probably dying out under the influence of a superstition."

FOUR-FINGERED PANGOLIN.

They burrow even in rather hard ground, and feed at night time. It has been noticed that the mother sits upright when enticing the young to suckle.

This *Manis* has rather a short head, and a wide body, and the tail is as long as the trunk: it is rather less in width near the body, and does not diminish much near the end. In a specimen which is twenty-five inches and a half long, the back of the animal is eight inches across, and the tail at its root is five inches broad. The scales are large, and are in about eleven rows. The body is of a pale yellowish-brown colour, the scales being lightest in tint near their points, and they are often streaked with yellow. Where the scales are wanting the skin is dusky brown. The eyes are reddish-brown, and the muzzle is black. The nails of the fore feet are bent under, so that the animal walks on their upper part. The scales are composed of hairs placed side by side and agglutinated together, and when first formed, and for some little time after, they are soft. They cover the upper part of the fore and hind extremities besides the body, and are striated. This kind lives in Eastern Africa, Sennaar, Caffraria, Kordofan, and Latakoo.

THE LONG-TAILED, OR FOUR-FINGERED PANGOLIN.*

This Ant-eater is from two to three feet in length, and the tail is twice as long as the body. It inhabits the Guinea Coast and the Gaboon, and probably Senegal. It is a dark brown animal, with the hair of the face and under sides black in tint. There are eleven series of scales, with the end rounded, and a central prominence.

Buffon described a pale brown or horn-coloured, very scaly, long-tailed Ant-eater as a Phatagin, but it is correctly called *Manis tricuspis*, from the scales having three projections on them. It lives in Western Africa, Fernando Po, Guinea, and Sierra Leone.

THE GREAT MANIS.†

This scaled Ant-eater is thirty inches long in the body, and its tail measures twenty-five inches in length. The great tail lessens to the end, and the scales are striated at the base, the whole colour being pale brown. It is an interesting animal from its likeness to one of the Asiatic species, the *Manis pentadactyla* (Linn.); but the difference in the length of tail is remarkable. It has been found in West Africa, Guinea, and in the Cape Coast Castle district.

THE ASIATIC SCALY ANT-EATERS.

There is one point of great interest about the genus *Manis*, and it is that it is not restricted to Africa, for some species are found over a wide extent of country in India. They live there in a region from the Himalayan Mountains to Ceylon, and eastward to Sumatra and Java, and in Southern China as far as Amoy, Hainan, and Formosa. They afford an instance of closely-allied animals now living in large districts which are separated by seas, deserts, mountains, and rivers, and other impassable barriers. The Javanese are said to have called the animal, from the fact of its rolling itself up, Pangolin, and the Bengalese termed it the Reptile of Stone. The first to be noticed is—

THE SHORT-TAILED, OR FIVE-FINGERED PANGOLIN.‡

This is supposed to be the Phattage of Ælian, and much resembles Temminck's *Manis* from South Africa. It has a small head, which is pointed and long at the muzzle; the body is rather stout, and the tail is short, broad at the root. The back scales are in longitudinal rows, eleven in number, and they are smaller than those of the African kind. It has the under part of the body, head, and feet naked, and more or less hairy, and some long, fair-coloured hairs spring from between the scales. The middle claw of the fore-foot exceeds the others in size. They feed on white Ants especially. They are found in Bengal, Madras, and Assam.

A *Manis* with a tail as long as the body, and with the scales of the hind feet acutely pointed, and the front and hind claws nearly equal in size, is found in Sumatra and in Java. Finally, the other Asiatic kind, *Manis Dalmannii*, is found in the Himalayas, China, and possibly in Java.

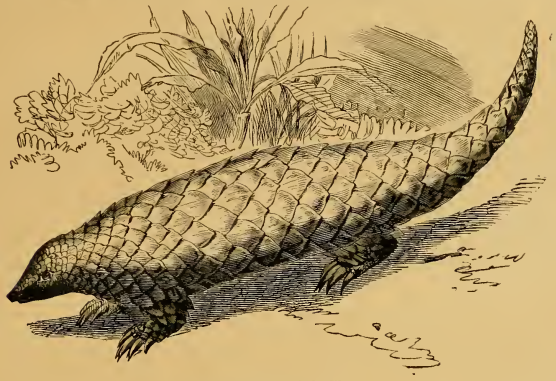
All the species of the genus *Manis*, whether from Africa or Asia, are absolutely toothless, and the Edentate peculiarity is perfect, for there are no back teeth. The tongue is worm-like, round, very long, and can be stuck out far from the mouth, and it supplies the want of the teeth, but from having this long organ and no back teeth, the palate and the skull are very long and conical. Being without masticating teeth, the lower jaw is very flat and simple, and there is no ascending ramus. The muscles of the lower jaw being of secondary importance, the arch (zygoma) of bone between the face and the ear is incomplete, and the outside ear is very small. But the organ of hearing is somewhat complicated, and there is a large space in the temporal bone which communicates with the internal ear, so that one tympanum is in communication with the other.

Much saliva is required to moisten the tongue, and the sub-maxillary glands are therefore very large, and reach down under the skin of the neck on to the chest. The stomach is usually, if not always, found to contain stones which the creature has swallowed. Of course it can hardly tell what may be on its tongue in the dark Ants' nest, and earth and stones are likely to rest on it and be swallowed, but the constant presence of these hard things may have something to do with the absence

* *Manis tetradactyla* (Linn.). † *Manis gigantea* (Illiger).
‡ *Manis brachyura.*—*Manis pentadactyla* (Linn.).

of the teeth, and the necessity of having a crushing material somewhere or other. The walls of the stomach are thin near the entry of the gullet tube, but towards the pylorus, or the right side end, the muscles are well developed, and the mucous membrane is very dense.

These animals use their claws for the purpose of digging holes in the ground, or in the Ants' nests, for the sake of food, and the position in walking is with the front claws bent under, so that the whole weight of the front of the body is felt on the back (or upper part) of the claws. The hind feet are placed flat, and the sole and under part of the claws sustain the hinder quarters. The joints of the five fingers of the fore feet are so arranged that they can bend downwards only, and indeed they are more or less permanently bent, being kept in that position by strong ligaments. This assists the digging powers of the claws, which are, moreover, forked at their points in some species, and the wrist is rendered very strong by having the joints between two of its bones abolished, and they are united by bone, as in the carnivorous animals. The bones thus united are the scaphoid and semi-lunar bones. Every structure in the creature's fore limbs tends to the promotion of easy and powerful digging,



FIVE-FINGERED PANGOLIN.

and as the motion of scratching the ground is directly downwards and backwards, the power of moving the wrist half round, and presenting the palm more or less upwards, as in the Sloths and in man, does not exist. In order to prevent this pronation and supination, the part of the fore-arm bone, the radius, next to the elbow, is not rounded, but forms part of a hinge joint. Finally, it is necessary to observe, that the middle claw is the longest of the five on all the extremities, and that as the animal does not require to reach over its head, there is no collar bone.

The long tail of the Pangolins, stumpy at the end in some kinds, has a considerable number of bones, usually twenty-six ; and the first of them joins on to the last of the back bones of the pelvis. This last, or sacral vertebra, unites on each side with the haunch bones (ischium), and there is no notch in the bone for the passages of the great nerves of the back of the leg, but a hole.

The thigh bone is flattened from before backwards, and the bones of the leg are wide apart, and all this gives extra powers to the muscles which have to direct the scraping and digging by the hind feet. The feet are solid and strong, and have not any of the inside turning and club-foot appearance of the Sloths, and the heel bone projects backwards.

There is an interesting peculiarity about the chest of the Pangolins, for the breast bone is very long, and the cartilage at its end is large, and has two long projections resembling those of the Lizards. The neck consists of seven vertebræ, and the back of thirteen, and there are three or four in the sacrum.

THE AMERICAN ANT-EATERS.

The adjective "long" may be applied to nearly all the structures of these animals. The tail, body, neck, head, snout, and tongue, and the hair are all very long, and the only things which are short are the ears. The observer is immediately struck with the curiously-shaped head, so narrow, low, and ending in a flexible and very slender snout, especially if the round tongue happens to be projecting out of the mouth, for it is longer even than the head, and is like a gigantic worm. The snout appears bent, and is made to look all the longer, by the eye being placed not far from the small ear. Then the huge bushy tail, flattened from side to side, as long as the body, has a fringe of very long and strong hair. The body itself moves on four powerful limbs, well clawed, and looks bulky from the quantity of hair on it, but usually it is thin. The animal, when it stands still, is higher at the shoulders than behind, and it rests on the sides of the fore-feet, where there is a callous pad, the claws being bent inwards and under, and not touching the ground with their tips. The under part of the hind feet bears the weight of the hind limbs. It is about four feet and a half in length from the snout to the tail, the tail being rather more than three feet in length, and the height is about three feet and a half. So long is the head, that it measures thirteen inches and a half from the ear to the snout, and the tongue can be projected for sixteen or eighteen inches, and is, when brought back into the mouth, bent so that its tip looks backwards towards the throat.

The animal belongs to a group of the Edentata (for it is toothless) which has the following genera:—One genus, which is now being considered, is *Myrmecophaga*—μύρμηξ (an Ant), and φαγεῖν (to eat),—a second is *Tamandua*, and the third is *Cyclothurus*, from κυκλωτός (rounded). The animals of this group represent in South America the Pangolins and Cape Ant-eaters of the Old World.

The species of the genus *Myrmecophaga*, which has been thus slightly alluded to, is called the Maned Ant-eater.

THE GREAT ANT-BEAR.*

The habits of this animal, which has been named Great Ant-Bear by the English and Spaniards, have been described as follows:—"The habits of the Great Ant-Bear are slothful and solitary; the greater part of his life is consumed in sleeping, notwithstanding which he is never fat, and rarely even in good condition. When about to sleep he lies on one side, conceals his long snout in the fur of the breast, locks the hind and fore claws into one another, so as to cover the head and belly, and turns his long, bushy tail over the whole body in such a manner as to protect it from the too powerful rays of the sun. The female bears but a single young one at a birth, which attaches itself to her back, and is carried about with her wherever she goes, rarely quitting her, even for a year after it has acquired sufficient strength to walk and provide for itself. This unprolific constitution, and the tardy growth of the young, account for the comparative rarity of these animals, which are said to be seldom seen, even in their native regions. The female has only two mammæ, situated on the breast, like those of Monkeys, Apes, and Bats. In his natural state the Ant-Bear lives exclusively upon Ants, to procure which he opens their hills with his powerful crooked claws, and at the moment that the insects, according to their nature, flock from all quarters to defend their dwellings, draws over them his long, flexible tongue covered with glutinous saliva, to which they consequently adhere; and so quickly does he repeat this operation, that we are assured he will thus exsert his tongue and draw it in again covered with insects twice in a second. He never actually introduces it into the holes or breaches which he makes in the hills themselves, but only draws it lightly over the swarms of insects which will issue forth, alarmed by his attack. 'It seems almost incredible,' says D'Azara, 'that so robust and powerful an animal can procure sufficient sustenance from Ants alone; but this circumstance has nothing strange in it to those who are acquainted with the tropical parts of America, and who have seen the enormous multitudes of these insects, which swarm in all parts of the country to that degree that their hills often almost touch one another for miles together.' The same author informs us that domestic Ant-Bears were occasionally kept by different persons in Paraguay, and that they had even been sent alive to Spain, being fed upon bread-and-milk mixed with morsels of flesh minced very small. Like all animals which

* *Myrmecophaga jubata.*

GREAT ANT-BEAR.

live upon insects, they are capable of sustaining a total deprivation of nourishment for an almost incredible time."

The Great Ant-Bear is found in all the warm and tropical parts of South America, from Columbia to Paraguay, and from the shores of the Atlantic to the foot of the Andes. His favourite resorts are the low, swampy savannahs, along the banks of rivers and stagnant ponds. He is found also frequenting the humid forests, but never climbing trees, as falsely reported by Buffon, on the authority of La Borde. His pace is slow, heavy, and hesitating; his head is carried low, as if he smelled the ground at every step, whilst his long, shaggy tail, drooping behind him, sweeps the ground on each side, and readily indicates his path to the hunter; though, when hard pressed, he increases his pace to a slow gallop, yet his greatest velocity never half equals the ordinary running of a man. So great is his stupidity, that those who encounter him in the woods or plains may drive him before them by merely pushing him with a stick, so long, at least, as he is not compelled to proceed beyond a moderate gallop; but if pressed too hard, or urged to extremity, he turns obstinate, sits up on his hind quarters like a Bear, and defends himself with his powerful claws. Like that animal, his usual, and indeed only, mode of assault is by seizing his adversary with his fore paws, wrapping his arms round him, and endeavouring by this means to squeeze him to death. His great strength and powerful muscles would easily enable him to accomplish his purpose in this respect, even against the largest animals of his native forests, were it but guided by ordinary intelligence, or accompanied with a common degree of activity. But in these qualities there are few animals, indeed, which do not greatly surpass the Ant-Bear, so that the different stories handed down by writers on natural history from one to another, and copied, without question, into the histories and descriptions of this animal, may be regarded as pure fiction. For this statement we have the express authority of Don Felix d'Azara, an excellent observer and credible writer, from whose "Natural

History of the Quadrupeds of Paraguay" we have derived the greater portion of the preceding account of the habits and economy of this extraordinary animal. "It is supposed," says Don Felix, "that the Jaguar himself dares not attack the Ant-Bear, and that if, pressed by hunger, or under some other excitement, he does so, the Ant-Bear hugs him and embraces him so tightly, as very soon to deprive him of life, not even relaxing his hold for hours after life has been extinguished by his assailant. It is very certain that such is the manner in which the Ant-eater defends himself; but it is not to be believed that his utmost efforts could prevail against the Jaguar, which, by a single bite or blow of his paw, could kill the Ant-eater before he was prepared for resistance; for even in so extreme a case, his motions are so slow and so heavy, that he takes some time to get himself ready, and besides being unable to leap, or to turn with even ordinary rapidity, he is necessarily forced to act solely on the defensive." The flesh of the Ant-eater is esteemed a delicacy by the Indians and negro slaves, and, though black, and of a strong musky flavour, is sometimes even met with at the tables of Europeans.

This large Ant-eater, grey in colour, with a black-coloured throat and a triangular spot, black in tint, ascending obliquely over each shoulder, has four claws on the fore limb and five on the hinder extremity. The claws are grooved underneath, and are not split or forked as in the *Manis*, and they, and especially the great middle claw, are protected by an expansion of bone from the last joint of the digits, or toes. This envelopes the base of the claw, except quite underneath, leaving the tip free to perform its office without endangering the tender base. The tips are protected, moreover, in the fore limbs by the position assumed during standing and walking, for they are then turned in and do not touch the ground; but this is not the case in the feet, for the Great Ant-Bears rest on their soles. Without teeth, and having an incomplete arch of bone between the cheek and ear bones, they possess a long palate, so long, indeed, that when the long nose cavity opens into the throat in the skeleton certain bones called pterygoid, or wing-shaped, form part of its boundary. This is unusual amongst the Mammalia, and Huxley observes that it is only found in some of the Whale tribe (*Cetacea*). Moreover, it is not noticed in any other vertebrate animals except the Crocodiles. The skull is very low and long, and the framework of the tongue is as important as that of the jaws. This kind of Ant-eater has imperfect collar bones. As in the other Ant-eaters there is in this one a very muscular condition of the right side of the stomach.*

THE TAMANDUA.†

The Tamandua is much smaller than the Great Ant-eater, and is, were it not for its long snout and tail, somewhat like a Sloth. It is nearly as large as one of these animals, and has a long head, small rounded ears, and small mouth. The body, some two feet in length, is rather short, and is covered with short, silky, or woolly shining hair, of almost uniform length. The fore limbs are very stout, especially above the elbow, and the hind ones rest on the rather long sole. The tail is about a foot and a half in length; it is stout at its root, and round and tapering to the blunt end, is minutely scaled, and covered in some places with short hairs. The fore claws are bent on the hand, and the animal walks on their outer and upper surface, using them also to clasp and to hang on in climbing. The tail is more or less prehensile. The colour of the hair and the markings varies much in the species, and in captivity the rusty straw-colour of the body becomes whiter; but there is a line of black on the upper part of the chest reaching over the shoulders and between them and the neck on to the back, and also several black patches over the tail and on the flanks.

The Tamandua is an inhabitant of the thick primeval forests of tropical America, and lives in Brazil and Paraguay. It is rarely found on the ground, but resides almost exclusively on trees, where it lives upon termites, honey, and even, according to the report of D'Azara, bees, which in those countries form their hives among the loftiest branches of the forest, and, having no sting, are more readily despoiled of their honey than their congeners of Great Britain. When about to sleep, it hides its muzzle in the fur of its breast, falls on its belly, letting its fore feet hang down on each side, and wrapping the whole tightly round with its tail. The female, as in the case of the Great Ant-eater, has but two pectoral mammæ, and produces but a single cub at a birth, which she carries about with

* It is certainly remarkable that the brain of this animal should present numerous convolutions, whilst the brain of the Sloth has barely any. The commissures of the brain are large, especially that of the centre, or corpus callosum, and also the anterior. The uterus is simple, the os is double, and the placenta is said to be discoidal.

† *Tamandua tetradactyla.*

her on her shoulders for the first three or four months. The young are at first exceedingly deformed and ugly, and of an uniform straw-colour.

The animal is called Cagouaré by the Guaranis, on account of the noxious and infected vapours of the forests in which alone it is found, the word literally signifying, in the language of those Indians, "the inhabitants of a stinking wood or marsh." Such at least is D'Azara's interpretation of the term, though it appears more probable that it may refer to the strong disagreeable odour of the animal itself, which, this very author informs us, is so powerful that it may be perceived at a very great distance, particularly when the animal is irritated. Tamandua is the name by which it is known to the Portuguese of Brazil; the French and the English call it Fourmilier and Little Ant-Bear.

THE TWO-TOED ANT-EATER.*

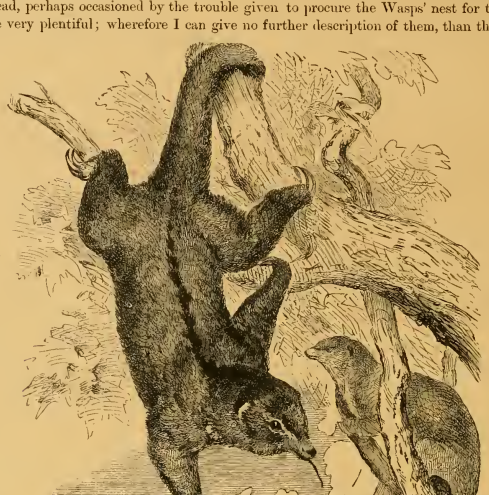
These little animals appear, at first sight, to resemble Sloths with tails; and their round heads, furry bodies, and two claws on the fore limb, add to the resemblance. They are essentially arboreal animals also, but they have long and useful tails, and live on insects. They hunt their insect prey in the forests of Costa Rica, Honduras, and Brazil. Their two-clawed hands are remarkable, for the rudiments of the thumb and little finger are hidden beneath the skin, and the claws are placed on the first and second digits. The third digit has no claw. There are four claws on the feet, so that in this arrangement the animal is peculiar amongst the Ant-eaters. It is not larger than a common Squirrel, and the general shape of the body is like that of a Tamandua on a small scale. Its whole length, from the snout to the origin of the tail, is but six inches, and of the tail, seven inches and a quarter. This is consequently rather longer than the body; it is thick at the root, and covered with short fur, but tapers suddenly towards the point, where it is naked and strongly prehensile. The muzzle is not so long, in proportion, as in the other two species; the tongue also is shorter, and has a flatter form; the mouth opens further back in the jaws, and has a much larger gape, the eye being situated close to its posterior angle; the ears are short, rather drooping, and concealed among the long fur which covers the head and cheeks; the legs are short and stout; and the hair, very soft and fine to the touch, is three-quarters of an inch in length on the body, but much shorter on the head, legs, and tail. The general colour is that of straw, more or less tinged with maroon on the shoulders, and particularly along the median line of the back, which usually exhibits a deep line of this shade. The feet and tail are grey.

This species is said to have four mammæ, two pectoral, as in those already described, and two others on the abdomen. It is reported, nevertheless, to have but a single cub at birth, which it conceals in the hollow of some decayed tree. The habits and manners of this little animal, hitherto very imperfectly known to naturalists, are well described by Von Sach, in his "Narrative of a Voyage to Surinam."

"I have had two little Ant-eaters, or Fourmiliers, which were not larger than a Squirrel. One was of a bright-yellow colour, with a brown stripe on the back, the other was a silvery-grey, and darker on the back. The hair of each was very soft and silky, a little crisped; the head was small and round, the nose long, gradually bending downwards to a point; it had no teeth, but a very long round tongue; the eyes were very small, round, and black; the legs rather short; the fore-feet had only two claws on each, the exterior being much larger and stronger than the interior, which exactly filled the curve or hollow of the large one; the hind feet had four claws of a moderate size; the tail was prehensile, longer than the body, thick at the base and tapering to the end, which, for some inches on the under side, was bare. This little animal is called in Surinam 'Kissing-hand,' as the inhabitants pretend that it will never eat, at least when caught, but that it only licks its paws, in the same manner as the Bear; that all trials to make it eat have proved in vain, and that it soon dies in confinement. When I got the first, I sent to the forest for a nest of Ants, and during the interim I put into its cage some eggs, honey, milk, and meat; but it refused to touch any of them. At length the Ants' nest arrived, but the animal did not pay the slighest attention to it either. By the shape of its fore-paws, which resemble nippers, and differ very much from those of all the other different species of Ant-eaters, I thought that this little creature might perhaps live on the nymphæ of Wasps, &c. I therefore brought it a Wasps' nest, and

* *Cyclothurus didactylus.*

then it pulled out, with its nippers, the nymphæ from the nest, and began to eat them with the greatest eagerness, sitting in the posture of a Squirrel. I showed this phenomenon to many of the inhabitants, who all assured me that it was the first time they had ever known that species of animal take any nourishment. The Ants which I tried it with were the large white termites upon which fowls are fed here. As the natural history of this pretty little animal is not much known, I thought of trying if they would breed in a cage; but when I returned from my excursion into the country I found them both dead, perhaps occasioned by the trouble given to procure the Wasps' nest for them, though they are here very plentiful; wherefore I can give no further description of them, than that they slept



TWO-TOED ANT-EATER.

all the day long, curled together, and fastened by their prehensile tails to one of the perches of the cage. When touched they erected themselves on their hind legs, and struck with the fore-paws at the object which disturbed them, like the hammer of a clock striking the bell, with both paws at the same time, and with a great deal of strength. They never attempted to run away, but were always ready for defence when attacked. As soon as evening came, they awoke, and with the greatest activity walked on the wire of the cage, though they never jumped, nor did I ever hear their voice."

All these Ant-eaters have great glands (sub-maxillary) for the purpose of secreting the sticky saliva, and the tongue is most movable, and wriggles like an eel in feeding on milk. The Little Ant-eater has a *rete mirabile* of blood-vessels.

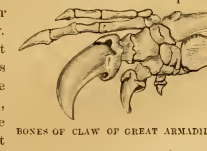
Another Cyclothurus lives in Costa Rica, which is golden-yellow in colour, and silky in its hair. It has a broad black stripe on the back.

CHAPTER III.

THE ARMADILLO FAMILY.

The Armour-plates—How the Shields are formed—Their connection with the Body—Description of the Animals—Mode of Walking—Diet—Skeleton—Adaptation of their Limbs for Burrowing—Classification—The Great Armadillo—Appearance—Great Burrower—The Tatouay—The Poyou, or Yellow-footed Armadillo—The Peludo, or Hairy Armadillo—The Pichiy—The Pera, or Black Tatou—The Mule Armadillo—The Ball Armadillo—Dr. Murie's Account of its Habits—Description—The Muscles by which it Rolls itself up and Unrolls itself—The Pichiciago—Concluding Remarks: Classification of the Order, Fossil Edentates, the Allied Species of *Manis* in South Africa and Hindostan.

These South American animals are more or less covered with a hard bony crust, separated into shields and bands, which are more or less movable, owing to the presence of special skin-muscles. In the most perfectly armoured there are four distinct shields and a set of bands, a certain amount of motion being possible between their edges. Of the shields, one covers the head, another the back of the neck, a third protects the shoulders like a great cape, and the fourth arches over the rump like a half dome, and is, in some, attached by its deep structure to the bones of the hip and haunch. The movable bands cover the back and loins, and are between the third and fourth shields. The tail may further be invested by incomplete bony rings, and scattered scales, and others are distributed over the limbs. This covering is, according to Professor Huxley, strictly comparable to part of the armour of the Crocodile; and the Armadillos are the only Mammals possessing such structure. The shields and bands are formed of many scales, or scutes, which are ossifications of the skin, and they may be of many kinds of shape—four, or many-sided—being united by sutures, and they are incapable of separate motion. The shields and bands, however, vary much in their number, size, and perfectness in the different animals, which, being armoured, the Spaniards called Armadillos; and, indeed, the number of bands in the back and loin division varies in individuals of the same species. These bands cover the flanks, and, with the shields fore and aft, protect the limbs, which are often more or less hidden by a growth of hair. The bands, moreover, by being movable one on the other, enable the rest of the armour to accommodate itself to the motions of the body, so that some roll themselves up, as in a ball shape. There may be few or many bands present, and the extreme numbers are three and thirteen. The Armadillos are of different sizes, and whilst the smallest may be only ten inches in length without the tail, the largest are more than three feet long. The head is long, and broad at the neck, the ears are usually long, the neck is short, the body is long, round, and low, and the length of tail varies much in different kinds. Where the head shield joins that of the shoulders, there is a space for the movement of the short neck; but this is protected by a backward projection from the head shield. The throat, under parts, and thighs are not protected by armour, except here and there by small plates in the skin, or by a granulated state of it; and they are naked or hairy. Even between the bands on the back there are often long hairs, and the tail fits into a kind of notch in the last shield of the body, and its plates are close in almost all Armadillos, but not united. So that much more motion is given to it and to the body than might be expected by the muscles during their action beneath the more or less soldered bony skin. The flat top to the head, and the long muzzle, are useful to the Armadillos in their burrowing, and this is assisted by short and strong limbs armed with powerful claws. Some of the Armadillos are even capable of running with some speed; and the little Six-banded Armadillo, or Poyou, and the Matico, are very restless and active in captivity. With one exception, these animals move with the flat of their feet and hands on the ground; all have five hind claws, but there is some variation in the number of the fore claws, which may be four or five. They have simple cylindrical molar teeth, which, according to the species, are from seven or eight to twenty-five on each side of each jaw, and they are separate, standing apart from one another. Moreover, they are so arranged that when the mouth is closed, the upper teeth fit into the spaces between the under ones, and the under teeth into those of the upper, so that their grinding surfaces wear down into ridges. In one kind, there are some teeth in the pre-maxillary



BONES OF CLAW OF GREAT ARMADILLO.

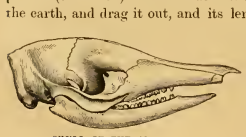
bones; but all the others have only molar teeth, which do not, however, go very far back, for there are none on the ascending ramus of the lower jaw. They are not, therefore, animals which prey upon their fellows, but are vegetable, insect, and probably carrion eaters. They dig and burrow, and their sense of smell is acute. This is assisted by the position of the nostrils in the long muzzle, for they are not at its tip, but rather underneath, so that they open downwards. In fact, the ends of the bones of the nose project in front of the pre-maxillary bones. The armour is doubtless useful against the attacks of their many carnivorous and reptile enemies; it assists them in burrowing, keeps off pressure, and may protect those which live in forests against a falling bough. They are passive creatures, mostly nocturnal in their habits, and their skeleton is strengthened in some parts in relation to its armour and its office.

Thus the spine of the second vertebra is tall and compressed, and reaches backwards over those of

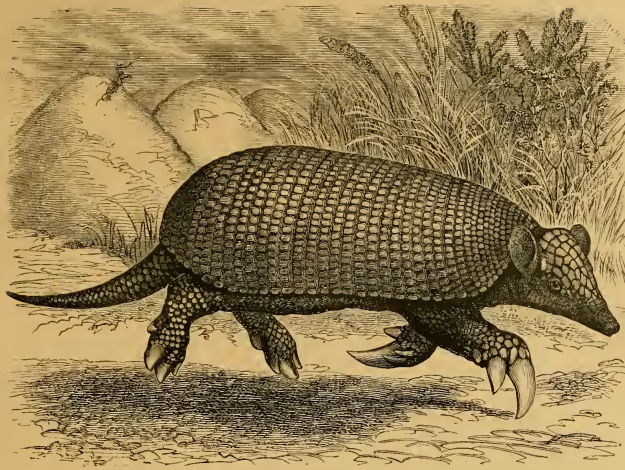
SKELETON OF THE ARMADILLO.

the third and fourth vertebræ, and it coalesces with them. The bodies of these vertebræ also join more or less solidly, and there are no (or very minute) spines on the last three cervical vertebræ. This gives a strange appearance to the skeleton, which is increased by the length of the spine of the first vertebra of the back (dorsal). In order to support the back shield, the projections from the back bones are greatly developed, and two side processes stand out on either side of the spinous one. Moreover, there is much fixity between the last dorsal and lumbar vertebræ, and the strong and long sacrum beneath the last shield is formed by the junction of the back bones of the root of the tail with the true sacral vertebræ. Finally, the transverse processes of some of the upper tail vertebræ are united to the pelvic bones. There is a corresponding strengthening of the chest, and a broad flat first rib accompanies an expanded condition of the upper part of the breast bone; and this bone is jointed with bony sternal ribs, which unite on the side of the chest with the ordinary ribs of the spine.

As they are rapid burrowers, the limbs are fashioned with a view of favouring this kind of life, the general skeletal peculiarities of the Edentata being more or less preserved at the same time. They have a collar bone, and the blade bone is long, rather narrow, and has a tall, long spine, and a kind of offshoot from the back edge. The humerus of the arm is short and robust, strongly marked by ridges and depressions for the great muscles of the shoulder and chest, and the fore-arm is characterised by the disproportionate size of its two bones. The ulna has a very long and stout elbow process (olecranon) for the attachment of the muscles, which can force the hand strongly on to and into the earth, and drag it out, and its length makes the whole bone twice as long as the radius. The thigh bone has a strong crest, arising from the great trochanter, and extending downwards nearly the whole length of the bone; moreover, the great trochanter has a large process on the middle of its outer edge. The bones of the leg are broad, arched, and united at both ends, and the heel bone reaches far back, in order to give strength to the squatting position taken up when the animal is burrowing. The eye is placed rather high in the head, is protected above by the outer edge of the head armour, and by some small surrounding scales. It looks as a rule outwards. The lower jaw is long, and has a back angle, sometimes of some size; the cheek bone unites to the temporal bone, and



SKULL OF THE ARMADILLO.



GREAT ARMADILLO.

the arch is complete. In the face the intermaxillary bone is well developed, and there is often a crest of bone passing over the top of the skull from side to side over the occiput, which is in relation to the head armour. The brain is small; the back or little brain is not covered by the brain proper, whose convolutions and processes are few and simple. The olfactory lobes project.

These armoured, round-bodied, short-legged, great-clawed animals are numerous, and there are several species, which need not, however, be collected into more than two genera. But it is by no means easy to arrange those of the first genus—the True Armadillos, genus *Dasypus*—in any other than an arbitrary and very artificial classification. Usually they are grouped and separated by the relative number of digits or claws on the fore and hinder extremities; by the presence or absence of teeth in the intermaxillary bones; by their ability to roll up; and by the excessive or the small number of their teeth. The method of walking, whether on the sole or on the tips of the claws, and the number of the bands, have been partly employed in classification, but their number is often variable in individuals of the same species.

BRAIN OF THE ARMADILLO.

The Priodontes have but one species, which is readily distinguished by its superior size, besides by its great number of teeth, of which there are from twenty-two to twenty-four small ones on each jaw on each side, making from eighty eight to ninety-six in all.

THE GREAT ARMADILLO.*

This is an inhabitant of Brazil, and of the northern parts of Paraguay and of Surinam, and is a dweller in the forest, being never found far out on the plains. The head is seven inches and a half long, and the ears, usually pointed and laid backwards, are not quite two inches in length. The head and body, without the tail, measure three feet and some inches, whilst the thickly-rooted but rapidly-

* *Dasypus gigas* (Cuvier).

tapering tail is about a foot and a half in length. Hence the head is small for the body in this Armadillo, and the forehead is protuberant, and the face is very tubular and cylindrical-looking. The shoulder and croup shields are not expanded and solid, but consist of nine and eighteen rows of plates respectively, and the intermediate part of the body has twelve or thirteen movable bands, each of which is made up of rectangular scales, or scutes, about half an inch square. The circumference of the root of the tail is upwards of ten inches, and the organ is covered with plates, disposed in rings at the root, and not farther down, but forming spiral or crescent-shaped lines throughout the rest of its length.

The Great Armadillo is a persevering and most rapid burrower, and the fore limb and hand are singularly modified for the purpose of enabling rapid digging and removal of the soil. The olecranon process of the ulna is enormous, and the muscle of the deep flexor or tendon of the claws is ossified and turned into a hand bone. The metacarpal bones of the thumb and first finger are small, and so are the slender digits, but that of the middle finger is irregularly rectangular, and is broader than long, and the digit which it supports is extraordinarily short, stout, strong, and broad. Its corresponding bones of the fourth finger are similarly formed, but are somewhat smaller, and the fifth finger is very small. The nail phalanx of the middle finger is large and strong, being curved *outwards*, and having a large horny hood, or core, at its base, for the lodgment of the claw. There are five claws on the hands and feet, and the Armadillo moves on the flat of its feet, being plantigrade. There is no doubt that, aided by these digging weapons, and being of considerable stoutness, the animal makes long and deep burrows. It feeds on roots, fallen fruit, and insects, and there is a story that it seeks carrion, and it used to be said that the collectors of Cinchona bark in the dense forests, when they lost a companion by death, were obliged to bury the body in a grave surrounded with a double row of stout planks, to prevent its being scratched up and devoured by the Great Armadillo. Planks must be scarce, however, in those localities, and difficult to carry; and probably there are other inhabitants of the woods besides the Armadillos which would discover and drag out a corpse. To assist the scratching and digging, the soles of the feet are partly covered with flat scales.

The Kabassous have the fore and hind extremities furnished with an equal number of (five) fingers and toes respectively, but the number of teeth is, altogether, from thirty to forty.

THE TATOUAY.*

This Kabassou has the five fingers disposed obliquely; and the great middle and fourth claws resemble those of the gigantic Armadillo. It is named in allusion to its tail, which is more or less naked, and nearly uncovered with rings or plates, so that it has not the usual tube-like protection, or beautifully ornamented crust seen in some Armadillos. The tail is about seven inches and a half long, and is round and pointed, having only a few hard crusts beneath, near the outer third, where it often trails on the ground. The rest of its root is covered with soft brown fur, interspersed with a few stiff short hairs on the upper surface. The ears are large, being nearly two inches in length, and they form a segment of a circle in figure. The body is round, and the shields of the shoulder and croup have seven and ten rows of scales respectively, each scale forming an oblong rectangle, those near the root of the tail being the largest. The movable bands are thirteen in number, and are composed of much smaller scales than those of the shields, and they have a nearly square outline. The head is long and larger in proportion than that of the Great Armadillo, and it has not the very cylindrical appearance noticed in that and some other species. The arrangement of the claws resembles that of the Great Armadillo, whose they almost equal in size. The female has two pectoral mammæ.

It inhabits Guiana, Brazil, Peru, Paraguay, and Surinam, and but little is known of the habits of these Armadillos. They burrow easily and rapidly, and their great claws enable them to grasp the earth, and fix themselves so thoroughly that a great amount of exertion is required to pull them out of a burrow. They live on insects and on vegetable matters.

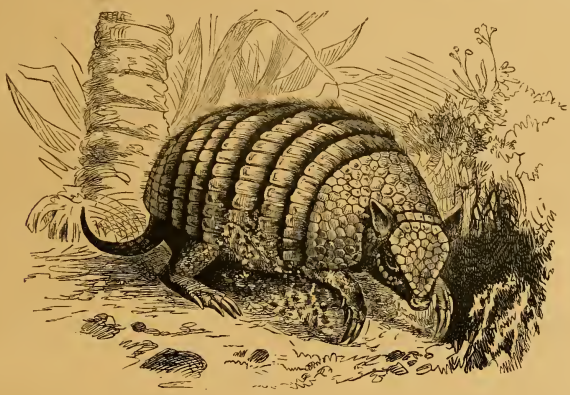
The Encouberts of Cuvier have five toes on the fore and hinder extremities, and nine or ten teeth

* *Dasypus Tatouay* (Desmarest).

on each side of the jaws, and there are two teeth in the intermaxillary bones of the upper jaw, representing the incisor teeth of ordinary Mammals, and thus forming an exception, not only to the other Armadillos, but even to the order of *Edentata*, as represented in the recent period.

THE POYOU, OR YELLOW-FOOTED ARMADILLO.*

This little Armadillo, which in captivity and in the natural state is remarkable for its boldness and restlessness, is a native of Brazil and especially of Paraguay, where it is common. It has a large, flat, nearly triangular top to its head, the face is short, the muzzle obtuse, and the ears erect and of moderate size. It has sharp little eyes. It measures about sixteen inches from the nose to the tail, and this is about seven or eight inches long. The number of movable bands is often six, but this is not the invariable number, for there may be seven or eight. The tail is surrounded, at its base, with three or four bony rings, and throughout the rest of its length is nearly covered with regular tuberculous



POYOU.

scales, the separations between the bands showing some long bristly grey hairs. The body is flat and broad, and has short legs, and the creature runs with a very active and determined gait. It is a strong little thing, and it is said that when it is chased, it will often get away from a man by sheer speed and activity. When any noise is made at the entrance of its burrow, or if it is teased by spectators around its cage, it comes forth and grunts like a Pig, and looks at the disturber with a bold inquiring look. When it is attacked it is powerless, and seems incapable of making any defence, but it retreats to its burrow, and getting to the bottom of it, digs deeper still. Its power of burrowing does not seem to be much diminished by the limited rotation of the fore-arm, to which there is no pronator quadratus, but a well-developed pronator teres.

The Poyou feeds much on carrion, and for this reason its flesh, though fat, is never eaten by the inhabitants of European origin, though the Indians make no distinction in this respect between it and other Armadillos. When it stops or rests, it has a custom of squatting close to the ground like a Hare on her form, and in this position the great breadth of the body becomes apparent.

The hinder shield has two hairs on the hinder side of each of its dorsal scales, and the under part of the body has scattered bristles on it. The female has two pectoral mammæ.

* *Dasypus sexcintus* (Linn.).

The next two Armadillos to be noticed were formerly included in the same group as the Poyou, but as they have not the incisor teeth on the intermaxillary bones, they are placed in the sub-division *Euphractes*.

THE PELUDO, OR HAIRY ARMADILLO.*

The long, silky, half bristly, abundant black hairs of this little Armadillo are the principal characteristics, which separate it, so far as its external construction is concerned, from the Poyou just noticed. It is smaller, however, the head measuring nearly four inches in length, and the whole body about two inches less than *Dasypus sexcintus*. The ears are long, large, and elliptical, and are pointed outwards, and the muzzle is broad. The forehead is broad and covered with rugged scales. The bands are six or seven in number, and the border of the shield, as well as that of the movable bands below, is indented in a remarkable manner, and forms sharp, regular points. There are eight teeth on each side, above and below, and the body, hairy as it is, is much scaled interiorly and on the limbs. The tail is long and slender, and only hairy at the root. This species does not inhabit Paraguay, nor probably is it found in the Brazils, but it exists in multitudes in the Pampas north of the Rio Plata, and Mr. Darwin noticed it in Chili. Its habits, according to that most accurate observer, are nocturnal, but D'Azara, to whom natural history owes very careful descriptions, states that "in an expedition which I made into the interior, between the parallels of 35° and 36° south latitude, I met with vast multitudes of this species of Armadillo, so that there was scarcely an individual of the party who did not daily capture one or two at least; for, unlike the Poyou, which moves abroad only at night, this animal is to be found at all times, and if alarmed, promptly conceals himself, if not intercepted. In March and April, when I saw them, they were so extremely fat that their flesh surfeited and palled the appetite; notwithstanding which, the pioneers and soldiers ate them roasted, and preferred them to beef and veal. This Hairy Armadillo, like others of the genus, has undoubtedly a very acute sense of smell, since it scents the carcases of dead Horses from a great distance, and runs to devour them; but as it is unable to penetrate the hide, it burrows under the body until it finds a place which the moisture of the soil has already begun to render soft and putrid. Here it makes an entrance with its claws, and eats its way into the interior, where it continues feasting on the putrid flesh, till nothing remains but the hide and bones, and so perfectly do these preserve their position, that it is impossible, from a mere external view, to anticipate the operations which the Armadillos have been carrying on within." The same author states that this species never constructs burrows to reside in, that it avoids low, damp situations, and is found only on the dry upland plains. Probably there is more than one Hairy Armadillo.

THE PICHIY.†

This little Armadillo is only fourteen inches long, tail included; its scaling is very handsome, and there are six or seven bands according to the individual and age. The head is covered with close scales, which are elliptical behind, and concealed under the others in front, and the whole top has a triangular outline, hiding the eye much. The scales on the front shield are large, and are hexagonal or pentagonal, and the croup shield has the angular endings noticed in the last species. The scales of the bands and of the shields generally are beautifully ornamented with lines, depressions, and little tubercles, which are more or less concentric. There is some hair on the long neck, and on the legs and tail. The five digits and claws on the fore limbs are moderately developed, for the thumb is very small, and the fourth finger only a little longer. But the index is long, with a short claw, and the second has a stouter and longer claw, and the third is shorter. It has a slender snout and small ears.

Mr. Darwin writes that it "prefers a very dry soil and the sandy dunes of the coast of Chili, where for many months it can never taste water. In soft soil, the animal burrows so quickly that its hind quarters would almost disappear before one could alight from one's horse." It also inhabits the Pampas to the south of Buenos Ayres, and extends from 36° lat. southward to the confines of Patagonia. It inhabits burrows, to which, however, it does not confine itself during the day. Its flesh is said to be remarkably tender and well tasting. It is a hardy species, and can live in the dreary solitudes of Port Desire on the east coast.

* *Dasypus villosus* (Desmarest). † *Dasypus minutus* (Desmarest).

The Cachicames, another group of Armadillos, were so called after the Indian name for a black kind, which has a very long tail, and which is the type of it.

The two kinds included in the group have four fingers, and five toes, which are separate, and the backs of the feet are round and covered with scales. The claws are conical, and the animal walks, as it were, on the toes more than on the sole, being thus digitigrade. The teeth number about eight on each side above and below.

THE PEBA, OR BLACK TATOU.*

This Armadillo has a very wide geographical range, extending from Texas, through Central America to Guiana, Brazil, and Paraguay, and a variety called *Dasypus Kappleri* inhabits Surinam. It has great ears, which are long and placed very close together, and the muzzle at the end of the long, tapering face is not unlike that of the snout of a Hog in shape. The head is small, long, and straight, but the mouth is large. There are eight teeth on both sides of both jaws. The body is hairy below the shields and bands, which are largely developed. Then the neck and shoulder shield extends far back and comes as low as the elbow, and is composed of numerous scales disposed in many concentric rings, having the concavity in front, the first embracing the neck in its curve. The croup shield extends from the back to the origin of the tail, and reaches as low as the knees, and the concavity of its rings is turned towards the rear, the last embracing the tail. These scales are hexagons. Between the shields the bands are marked with zigzag lines forming very acute angles, and in some degree gliding over one another according to the movements of the animal. Out of fourteen specimens, two had six, one had seven, seven had eight, and there were four with nine bands; the full-grown ones have the greatest number. The head shield descends from the ears to the muzzle, and covers the cheeks as far down as the eyes, and there are small, interspersed, detached scales over the throat, the under jaw, the legs, and feet. The body is sixteen inches long, and the tail is nearly as long—fourteen inches—and is stout at the root. One variety of the species has some of the rings of the tail soldered into a case, which is used as a horn by the Indians. It is a timid, nocturnal animal, tolerably swift-footed and very expert in burrowing. It is never found in the woods, but delights in the open plains and cultivated fields, and is much hunted on account of the delicacy of the flesh, which, when roasted in the shell, is fat, and something better than Sucking-pig in taste. These long-tailed Armadillos bury garbage and flesh in their burrows, and eat it at their leisure.

Another species of this group is the Mule Armadillo (*Dasypus hybridus*, Desmarest), which has long, straight ears and a short tail. It roams farther north than the other kind, and is common on the Pampas, and is not nocturnal, nor does it burrow very easily. The female has from eight to twelve young at a birth, and the individuals of a litter are often of one sex.

The Armadillos of all kinds, it is said, only have one litter a year, and then the young are numerous, but the mother has never more than four teats, and many have only two.

The last group of the Armadillos, the *Tolypeutes*, contains some remarkable species, which have the power of rolling themselves up as in a ball-shape, and they walk in a most extraordinary manner on the tip of long and powerful front claws, and also on the flat and tip of the hind ones.

THE BALL ARMADILLO.†

This is a small and very beautifully ornamented Armadillo, which has three free central bands and a short tail, with large fore and aft shields. It rolls itself up on the slightest alarm, so that the great shoulder and croup shields meet, the head and tail fitting in exactly, in front, so as to close up the body very safely. The little animal, which is rarely more than fifteen inches long, and has a tail of a couple of inches in length, is found in Brazil, Paraguay, and Buenos Ayres, and its walking on the long, stout claws of the fore legs gives it a very curious and unsteady appearance.

It is an active, sprightly, light-footed little thing, according to Dr. Murie, and is constantly on the move, going here and there with much vivacity. Poising itself on tiptoe, it trots backwards and forwards as if on some urgent errand. In captivity the food was raw meat, boiled eggs, and bread-

* *Dasypus Peba* (Desmarest). † *Dasypus* (*Tolypeutes*) *apar* (Geoffroy).

BALL ARMADILLO.

and-milk. In the forest land, where it dwells along with its fellow armoured creatures, it has the advantage of being able to curl itself up, and to present no tangible part of its body to the host of mischievous Monkeys of its locality. The other Armadillos, when retiring to their holes, are often set upon by their lively quadrumanous neighbours, and are dragged out by the tail with great gusto; but the little Tolypeutes curls himself up and laughs at the disappointed Monkeys, who can find nothing to pull at about him.

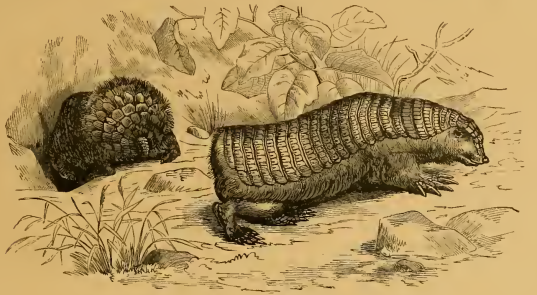
The shoulder shield comes down like a flap, far in front, and the croup extends behind in the same way, and they and the bands have large scales, which are very pretty in shape and ornament. The shields are very stout, and so is the skeleton within. The fore foot has three large clawed toes, on the tips of which the animal walks. The thumb of the fore extremity is to be seen in the skeleton, but is not always visible in the skin, and it is very small and high up; the index is long, and the claw also, and it is slightly bent, but sharp at the tip. The next claw is the largest and longest, and has a cutting edge at the back and outer part, and the point is sharp. The next digit is smaller. In the hind foot there are five toes, one being high up and rudimentary, and the second and third having broad, flat, curved, short nails, the third being the greatest. The fourth nail is smaller, and they are all placed more or less flatly on the ground.

The shell of this Armadillo is blackish-brown, and the skin between the central bands is bald and smooth. There are nine back teeth on each side in both jaws, and there are none in front. The muscles which enable this Armadillo to bring its tail and nose together and to form a ball shape, are not simply expansions of the common muscular tissue, which exists deeply in the skin in so many animals, but are special structures. The most important are in relation to the position of the head, neck limbs, tail, and the shields and bands, when the body is about to be and while it is being rolled up: and these roller-up muscles are so arranged as to permit of the large liver and other internal organs not suffering pressure during their natural or temporary displacement. On the other hand, the unrollers act when the body and bones are in the rolled-up condition. The muscles of the back are very tendinous, and to a degree they unroll the animal, but this is also performed by muscles which are attached underneath the first movable band of armour, and to the front part of the spine of the blade

bone; this will tend, when it contracts, to pull out the legs and protrude the fore part of the body, the centre being still rigid. Another drawer-back of the bladebone assists in this action, and it is inserted into the front or chest shield. The rolling up is done by the action of muscles which draw the nose down, so as to make the long head at right angles to the neck; then the fore-legs and bladebones are drawn in and up. At the same time, the muscles which pull down the tail act on the hind shield, and draw it down and forwards. The legs are pulled up, and then a great muscle, which is largely attached to the front and hind shields, and has a tendon-like expansion in the middle of its course beneath the movable bands, contracts and pulls front and stern together. The muscles of the loins, which in jumping animals bring the spine to a curve, do not act, and indeed are excessively small. The chief bend in the back is between the second and third lumbar vertebræ. (Murie.)

GENUS CHLAMYDOPHORUS.—THE PICHICIAGO.*

This is an Edentate animal, resembling the Armadillos more than any others, and is about six inches in length. It has a conical-shaped head, a large full chest, short clumsy powerful fore limbs,



PICHICIAGO.

with four great nails rising gradually one above the other, the external shortest, and broadest; and the whole so arranged as to form a sharp-cutting instrument, rather scooped, and very convenient for progression under ground. The back and croup are broad and high, and the tail is small. The hind legs are weak and short, the feet being long and narrow, and there is a well-defined heel. The foot is arched, the toes are separate, and the nails are strong. The whole surface of the body is covered with fine silk-like hair, which covers over the limbs on to the palms. But the most striking peculiarity is the long-banded shell, which is loose as it were throughout, being attached to the back immediately above the spine by cellular tissue. It rests on two knobs on the frontal bones, and these are the great attachments of this important covering. There are twenty-four bands and no separate shields, and their consistence is somewhat more dense than leather of the same thickness. They are composed of scales or plates of geometrical form, and the bands are separated by skin. There is a notch in the last band for the tail, and the free inferior edges of the bands are everywhere fringed with silky hair. This elongated band structure is moved, to a certain extent, by two broad thin muscles, which are beneath it, on the back, and each of which divides, on approaching the shoulder, into two portions, one being attached to the bladebone, and the other to the occiput.

The ear is hidden by hair, and is small; so also is the eye, which is black. The nostrils open downwards, at the inferior border of a large cartilage. The mouth is small, and there are eight teeth on both sides in both jaws. They are simple molars, and are separate and cylindrical. The head is large behind, and the jaws come almost to a point, and the lower has a long ascending ramus. A

* *Chlamydophorus truncatus* (Harlan).

great passage for the spinal cord, and the two processes on the frontal bone, add to the curious appearance of this "bumpy" skull. The pelvis is remarkable in its structure, and is open in front.

Some of these animals have the bands of the armour not attached, as has been mentioned, to the muscles of the back and to the head, but have them adherent to the skin of the back to the edge; and the sides and under part of the body are then covered with woolly hair. These are the largest animals of the two, and are found in Bolivia. The others are from Mendoza and Chili. These curious animals live, partly, mole-like lives.

From what may be gleaned by reading the previous pages about the Edentates, it will appear that the order is a very remarkable one, and that it is interesting on account of the different external appearance of the species, their diverse modes of life, and singularly restricted localities. Evidently, there has been much degeneration in some of the anatomical characters of many of the species, and especially in those whose foot bones and neck vertebræ have joined more or less. The singular resemblance which some species present, in various points of their anatomy, to the lower animals, is very interesting, as is also their wonderful relation, in points of structure, with a number of extinct Edentata, most of which were gigantic.

The Edentata, called also Bruta by Linnæus, form an order, the characters of which are, that there are teeth of one or two kinds all very similar, and often wanting. The incisors are not developed except in one group, and the rest have either molars which are separate, and numerous and simple, or there are none. The extremities are clawed, and the tongue is more or less elongated. The great groups of this order are the *Tardigrada*, or slow movers, which have a short face, long limbs, and small tail, and the body is covered with crisp hair; and the *Effodientia*, or diggers, which have long faces and worm-like tongues, with short limbs.

The Sloths form the only family of the Tardigrada, and the Effodientia are divided into the genera *Manis*, the scaly Ant-eaters; *Dasypus*, the Armadillos; *Chlamyphorus*, the Pichiciagos; *Orycteropus*, the Ant-Bears; and *Myrmecophaga*, the American Ant-eaters. The Sloths form three genera —*Cholœpus*, *Bradypus*, and *Arctopithecus*. Amongst the Ant-eaters, the genus *Manis* may stand alone. The genus *Dasypus* may be divided, for the sake of convenience, into the subdivisions Priodontes, Kabassous, Euphractes, Cachicames, and Tolypeutes. The other genera need no subdivision.

The fossil Edentata are mostly gigantic, and formerly lived in Europe and in the Americas. The European kinds would, were they now living, belong probably to the group of Pangolins, and they are placed in the extinct genera *Pervatherium*, *Macrotherium*, and *Ancylotherium*. In the Pliocene deposits of North America, there are large Edentates belonging to the genus *Morotherium*, and the previous Miocene deposits contain *Moropus*. The later, or Post-Pliocene strata of North and South America, contain species of *Mylodon* and *Megalonyx*, *Megatherium*, *Scelidotherium*, *Cœlodon*, and *Sphenodon*; they constitute a group of Terrestrial Sloths—the Gravigrada. In Cuba, the fossil huge Gravigrade Sloths are of the genera *Megalocnus* and *Myomorphus*. The Armadillo group are found fossil in South America, and the genera are *Chlamydotherium*, *Euryodon*, *Heterodon*, *Pachytherium*, and *Schistopleuron*. The modern genera are found with these, and the gigantic Armadillo-like animal, the Glyptodon, lived contemporaneously with the others, and possessed many strange peculiarities in its skeleton. The Ant-eaters are represented by a fossil form called *Glossotherium*. The oldest Edentates of the American Continent are found in North America, unless there is a Miocene group of them in South America, which is by no means an improbable supposition. The European Ant-eaters now found fossil lived in the Eocene, Miocene, and Pliocene ages.

With regard to the discovery of recent and closely-allied species of *Manis*, in South Africa and Hindostan, it may be said that they are relics of the old forms of the intermediate and now sunken land, between Eastern Africa and India, which existed before the last upheaval of the Himalayas. The evident structural affinity between the Effodient Edentata of South America and Africa, although the genera are different, adds to the interest of the corresponding, and in some instances greater, resemblance of many African and South American fresh-water fish and plants. The geologist looks back in the remote ages of the globe, when the great land surfaces and seas of the world were rather across the earth than in their present longitudinal position, in order to explain this remarkable similarity.

P. Martin Duncan.

KANGAROO.

(*From the Living Specimen in the Zoological Gardens, London.*)

ORDER MARSUPIALIA, MARSUPIAL OR POUCHED ANIMALS.

CHAPTER I.

SUB-ORDER MARSUPIATA.—THE KANGAROO AND WOMBAT FAMILIES.

THE GREAT KANGAROO—Captain Cook and the Great Kangaroo—Habitat—Appearance of the Animal—Marsupials separated from the other Mammalian Orders, and why (Footnote)—Gestation and Birth of Young (Footnote)—Mode of Running—The Short Fore Limbs—The *Marsupium*, or Pouch—Head—Dentition—Peculiarities in the Teeth—Hind Extremities—Foot—Great Claw—How the Erect Position is maintained—Whence their Jumping Power is derived—Other Skeletal Peculiarities—Kangaroo Hunts—Becoming Rarer—Mode of Attack and Defence—Hands—Bones of the Fore Limbs—Skull—Stomach—Circulation of Blood—Peculiarity in Young—Nervous System not fully developed—Brain—The Baby Kangaroo in the Pouch—THE HARE KANGAROO—THE GREAT ROCK KANGAROO—THE RED KANGAROO—THE BRUSH KANGAROO—THE BRUSH-TAILED ROCK KANGAROO—THE COMMON TREE KANGAROO—THE KANGAROO-RATS—Characteristics—THE RAT-TAILED HYPSIPRYMNUS—Description—THE WOMBAT FAMILY—THE WOMBAT—Peculiarities—Description—Habits—Teeth—Skeleton.

I. THE KANGAROO FAMILY.*—THE GREAT KANGAROO.†

IN the year A.D. 1770, the great circumnavigator, Captain Cook, was on the coast of New South Wales repairing his ship, and a party of sailors were sent on land, to procure food for the sick. They saw an animal whose description tempted Cook himself, and also Mr. Banks (afterwards Sir Joseph Banks), to land and go in pursuit of it the next day. The animal was seen in company with others of its kind, and its short front limbs, great hind legs, and huge tail, and the tremendous hops it made in its very fleet course, quite bore out the statements of the astonished crew. They had seen, for the first time, the Great Kangaroo in its wild condition and on its own ground. Soon afterwards a specimen was shot, and notes were made about the creature, and some skins were brought over to Europe.

The animal has now become familiar to the civilised world. It is, however, gradually receding before the Australian colonist and squatter; but formerly it roamed all over the plains of New South Wales, Southern and Western Australia, Queensland, and Van Diemen's Land, with only the aborigines for its enemies. It is called Bundaary and Bullucur by the natives of the Liverpool range and Murray, and the name Kangaroo is a mistaken native one.

On looking at one of the Great Kangaroos in some menagerie or zoological garden, the first peculiarities that strike the eye are its small fore limbs, its very large and long hind ones, and the great and thick tail. The smallness of the head, which has rather long ears, and a long dusky brown muzzle, the length of the body, and the comfortable grey-brown, thick, shortish fur, are then noticed. But the principal fact which impresses all these things upon the visitor, is that the female may have a little Kangaroo with its head poked out of a kind of pouch in the under part of the body. Sometimes the little one jumps out and gets in again if it is frightened, and the old one moves, hops, and jumps about, with its portable nursery, with the greatest ease.‡

Sometimes the Kangaroos may be seen feeding, and then the awkwardness of their gait becomes

* The *Macropodidæ*.

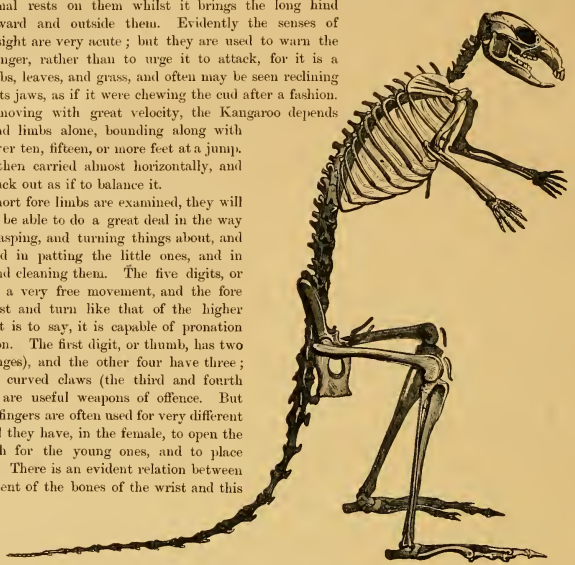
† *Macropus giganteus* (Shaw).

‡ The presence of the pouch, or marsupium, containing the teats, involves many structural and physiological peculiarities which separate the Marsupialia, in a classificatory sense, from the rest of the Mammalia. The Great Kangaroo, which may be considered a fair example of the Marsupials, has in the female a set of skin muscles, around the pouch, beneath the skin, which close it. The milk, or mammary gland, has four long, slender teats in the pouch, and beneath the skin of it is a muscle called the cremaster, which is largely developed. It spreads over the surface of the gland, and its action is to squeeze it and to force out the milk through the teat. There is thus protection for the young, and milk is given forth, without the effort of the young in sucking. The reason for this is obvious. The Great Kangaroo, which is often as tall as a man, is pregnant for about thirty-nine days only, and then a little one, not bigger than a thumb, is born; it is not completely formed, and is blind and cannot move itself. The mother places it in her pouch, and it fixes on to a teat, where it hangs for about eight months, and then it begins to look out of the pouch. The duration of the life of the young in the womb is thus very small, and it has no placenta there, which in the other and non-marsupial Mammalia forms the life-union between the mother and the offspring before its birth. Thus, the Marsupials form one great group of Mammalia which are "implacentalia," without placentas or "after-births," and all the other Mammalia are "placentalia," and have this link between mother and young. In all the Mammalia hitherto described the young come into the world by a single passage. In those now under consideration (the Marsupialia) there is a double passage, and the womb is separated into two portions, being double; so they are termed Didelphia. The marsupium has two remarkable bones more or less in relation to it, and all animals thus furnished are termed Marsupialia, and they form two sections or sub-orders—(1) The Marsupiata proper, with marsupial bones, mostly with pouches, and with inflected lower jaws. (2) The Monotremata, which have marsupial bones, depressions in the skin, when suckling, like ill-developed pouches, and beak-like jaws in front, which are not inflected.

evident; for the small fore legs and curious paws are on or very close to the ground, whilst the back part of the body is raised up by the long hind legs, and, as it were, balanced by the great tail. These hind legs seem to do nearly all the running, or rather jumping, both being used together; and the tail is of use in supporting the long body when the animal suddenly raises itself up straight, and squats on its hind quarters. The small front legs then appear quite stunted, and the ears stick up, and the small head is held straight. But in slow walking, the fore feet are placed on the ground, and the animal rests on them whilst it brings the long hind quarters forward and outside them. Evidently the senses of hearing and sight are very acute; but they are used to warn the animal of danger, rather than to urge it to attack, for it is a feeder on herbs, leaves, and grass, and often may be seen reclining and moving its jaws, as if it were chewing the cud after a fashion.

When moving with great velocity, the Kangaroo depends upon the hind limbs alone, bounding along with great ease, over ten, fifteen, or more feet at a jump. Its body is then carried almost horizontally, and the tail is stuck out as if to balance it.

If the short fore limbs are examined, they will be noticed to be able to do a great deal in the way of holding, clasping, and turning things about, and they are used in patting the little ones, and in embracing and cleaning them. The five digits, or fingers, have a very free movement, and the fore arm can twist and turn like that of the higher animals; that is to say, it is capable of pronation and supination. The first digit, or thumb, has two joints (phalanges), and the other four have three; and the five curved claws (the third and fourth being large) are useful weapons of offence. But they and the fingers are often used for very different purposes, and they have, in the female, to open the curious pouch for the young ones, and to place them there. There is an evident relation between the arrangement of the bones of the wrist and this necessary office or function. The *marsupium*, or pouch, is a kind of inbending of the skin of the lower part of the belly, and is moist and naked inside. In it, in the females, are the nipples of the mammary glands, and to these the very young Kangaroos* hang on for a long time, before they see the outer world. They are put in there by the mother, when they are just born, and when very small and not perfectly formed. They grow there, and after a while, leave the nipple when they think fit. As this pouch, with its contents, would drag upon the mother, it is kept from doing so, more or less, by two bones which are found amongst the muscles of the lower part of the body, and which are attached to the front or pubic bones of the pelvis. They are called marsupial bones. They exist also in the males, but they have no open pouch, for it is, as it were, turned outwards, and contains part of the reproductive organs.



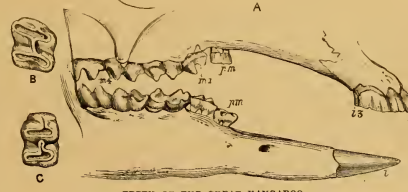
SKELETON OF THE GREAT KANGAROO.

The head is long, and is remarkable for the long nose, and large full eyes, with eyelashes, for the Kangaroo is not nocturnal in its habits, like most of the Marsupials. The upper lip is split, the end of the nose or muffle is naked or hairy according to the kind, and the brain-case is small. The nostrils

* See Footnote (‡) on previous page.

are at the side of the end of the muzzle, and are slit-like and oblique, and there are bristly "smellers" to the fleshy lips and chin. A slender tongue is sometimes seen for an instant whilst the Kangaroo is feeding, and if the bones of the jaws be examined, the angle, or lower part of the back of the lower jaw, will be found to be turned inwards.

The long jaws have not very many teeth, and there are two large lower front ones, or lower incisors, which project in a line with the lower jaw; they are horizontal and more or less pointed, but have an outer and inner cutting edge. The upper incisors, six in number, or three on each side of the middle line, are placed on the pre-maxillary bone, and they work up and down. They are broad and have the cutting edge below, and the outer one, on each side, is broad, grooved, and complicated by one or two folds of its enamel, which are continued from the outer side of the tooth obliquely forward and inward. There is a space or diastema behind the incisors. There are four premolars, one on each side of both jaws, and then follow four molar teeth above and below and on both sides of the mouth. The dental formula is thus—Incisors, $\frac{3-3}{1-1}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{4-4}{4-4} = 28$. There are no canine teeth in the adults, but their germs may be found in the very young Kangaroos. As the Kangaroo is a vegetable feeder, and delights in grass, leaves, and herbs, its teeth are eminently of a non-carnivorous kind. It may be remarked that when the mouth is closed, the cutting edges of the upper incisors come against the outer cutting edge of the long front teeth of the lower jaw. The true molars increase in size from front backwards; and the crown of each molar is squarish, but is longer than broad, and it has two principal cross ridges, which, when not worn, are tall, and have sharp edges. Besides these, there are two other transverse ridges which are smaller and not so tall. One of these is on the front part of the tooth, and the other on the hinder (in the upper molars only). Then there is a long ridge which connects the cross ones. They are all covered with enamel. When the tooth is worn, we find it presenting, according to Mr. Waterhouse,* two powerful loops or folds. On comparing these teeth with those of the herbivorous mammalia already noticed, a remarkable difference will be seen.



TEETH OF THE GREAT KANGAROO.
(A) Upper and Lower Jaw; (B) Upper Molar; (C) Lower Molar.

The hinder extremities consist of a nearly straight, long, cylindrical bone, the femur, which has a hemispherical joint head, and a large trochanter, which reaches above the joint; of two leg bones—the tibia, which is prismatic above and cylindrical below, but with only a slight inner ankle projection, and the fibula, which is distinct but thinned and concave in its lower half, where it is close and attached to the other bone, and forms the outer ankle projection. To these are added the bones of the ankle-joint and the clawed toes. The Kangaroo being a great jumper, and having a great tendon, the analogue of the tendo achillis of man, has a powerful projecting process of the hinder ankle bone for its attachment. But the great length of the foot is produced by the size of the fourth and fifth or two outer toes, and especially of the fourth, which often reaches a foot in length, including the metatarsal bone behind, and the pointed claw in front. The great claw looks like a long hoof, is three-sided and sharp-pointed like a bayonet, and with it the animal stabs and rips open the body of its opponent.† The outer claw is very small, and there is no great toe (or first), but the second and third are long and slender, and are united in a common skin, so as to look like a single toe with a double nail, the hair coming to the roots of it. The long narrow foot is nearly as long as the leg bones, and is admirably adapted for jumping forwards, as well as sideways, and for supporting, when the legs are widely separated, the weight of the erect body. The body in that

* Waterhouse's "Natural History of the Mammalia," order Marsupiata, from which much of this description of the order has been taken.

† R. Owen, "Marsupialia;" "Todd's Cyclopædia of Anatomy and Physiology."

position has the leg bones straight, the thigh bones oblique, and the pelvis and spine erect, the great tail being a prop behind. Owen remarks that in man it is the massive and expanded muscles of the back of the pelvis and upper part of the thigh, or the gluteal muscles,* which are the chief structures in maintaining the erect posture. But in the Kangaroo, the narrow bones of the haunch could not afford attachment to great gluteal muscles; so a muscle which is but slightly formed in man, and is called the little psoas, is greatly developed in the Kangaroo, and has evidently the power of maintaining the erect posture, although it is situate within the body and in front of the spine. The great jumping power is due to the leverage of the ankle and long toes, and the muscles which supply the tendon already mentioned, and others which have the same office. These are of great strength and size, and there are some accessory muscles to the thigh and leg. The long spine of the back has powerful processes, and the jar of the great jumps is received by two vertebræ which, anchylosed or united together, form the sacrum. The tail is made up of many vertebræ, and covered with muscles. The great blood-vessels running underneath it have many chevron, or V-shaped, bones, to protect them from pressure. The marsupial bones, one on each side, are long, and broad below; they are movable on the pubis, and afford attachment to muscular fibres, act as a pulley for others, and strengthen the walls of the abdomen. Formed within muscles and tendons, they are rather bony growths than parts of the true skeleton, and hence they may be absent in some of the order, although they are always present in the Kangaroos.

Although well provided with strong limbs and muscles, and acute senses, the Kangaroos living the life of the deer and cattle of other regions than Australia, are subject to the attacks of beasts of prey and hunters. In Australia the great Carnivora do not exist, but there is a native dog, the Dingo, aborigines, and trained dogs and colonists, who enjoy a Kangaroo hunt. The native dogs stalk and run them down, the natives spear them after sometimes forming a great circle and closing in and yelling and shouting. But the rifle and trained hounds have dislodged many more than the natives, and the animals are becoming scarcer near the settlements than in former years. Dogs which run by sight afford many an exciting hunt, and the Kangaroo starts off, bounding at a great rate, and clearing all sorts of impediments with ease. It is hard riding to keep up with the chase, and especially in hot weather, when the Kangaroo often escapes, thanks to its greater powers of endurance. Sometimes the Kangaroo will stand at bay, and will rip up a solitary Dog with its claws, or will kill with a single blow of the leg and tail. Three or more Dogs are usually laid on, one more fleet than the others, to "pull" the Kangaroo, while the others rush in and kill it. Mr. Gould† says that it sometimes adopts a singular mode of defending itself, by clasping its short, powerful fore limbs round its antagonist, leaping away with it to the nearest water hole, and then keeping it beneath the water until drowned.

Mr. R. Foulerton, who has paid some attention to the habits of the Marsupials, writes that the Great Kangaroo, although its numbers have been greatly diminished in some pastoral districts, still is numerous enough to render some runs almost worthless for pastoral purposes. They may be seen there in thousands, eating off all the best grass, and in the bad seasons reducing the cattle to starving point. They have few enemies but man, as even the native Dog will never attack them, unless they are very young. An "old man" Kangaroo is a formidable opponent; he will severely wound and even kill a man, unless approached cautiously. Their mode of attack is to "hug" him bear fashion, and then rip him with the hind foot. When pursued, they generally take to the water, and there stand at bay, and the luckless man or dog who gets within their grasp is forced under the water, and held there until drowned. The middle-aged Kangaroos, or Flyers, easily outstrip the hunting Dogs at the start, but they are gradually gained upon. When caught, the Kangaroo fights to the last.

The diminutive fore limbs are separated by narrow shoulders, and although the upper arm is short and well furnished with muscles, the fore arm is long, slender, but very movable. The hand is short and broad, and there are four curved, sharp claws, the first one, or thumb, being the smallest, and the third and fourth the largest. The hair covers over the fingers to the claws, which can separate widely, grasp and hold, and be bent on the palm. The movements of the wrists and fore arms are considerable, and a large and long upward-turning muscle is in the space between the ulna

* See also Vol. 1., page 58, Note.

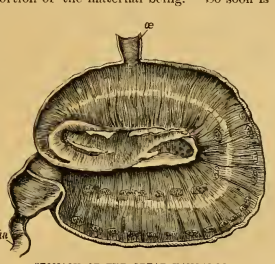
† Mr. Gould's works on Australian animals, occasionally quoted by me.

and radius (the bones of the arm). Moreover, the ulna joints with a cavity in the cuneiform bone of the wrist; and the first row of wrist bones has three in it, and the second has four. The first phalanges, or those of the thumb, are not placed as a thumb in relation to the wrist bones, and it is the outer fingers that grasp with their claws. As the Kangaroo has to lift up its arm, there is a collar-bone, and the arm bone (humerus) is perforated on the inner side of the end above the elbow; and the olecranon is long.

The bladebone has a curved ridge, and the muscles of the upper part are less than those which are attached to the part below it. There are thirteen pairs of ribs to the chest.

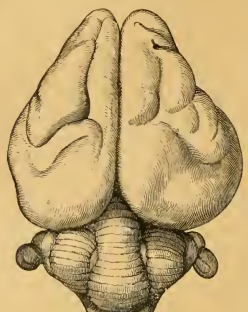
The skull is long and comparatively smooth, and even the ridges for the temporal muscles are only slightly raised; and in old Kangaroos the bones do not unite or anchylose as they do in the other Mammalia hitherto noticed. The teeth are not used as weapons of offence, but simply to graze with, and the lower jaw is not quite solid at the chin, but only so below, so that the lower incisors can be slightly separated. The ear-bone is remarkable for being separated into three parts, namely, the temporal or squamous, the petrosal, and the tympanic; and this is rather a reptilian character. Moreover, the air-chambers of the side of the under part of the skull are in the form of rounded prominences, or "bullæ." They are situated in the lower part of the ear-bone, called squamosal. The zygoma, or process between the cheek (malar) bone and the ear, is hollow, complete, and arched, its front part being, moreover, extended downwards in a projection which reaches below the grinding teeth, and resembles that of the Sloths somewhat. The lower jaw has its back part, or angle, bent inwards (or inflected) strongly, and this is, except in one set, a characteristic of the Marsupiata.

The Kangaroo, being a vegetable feeder, has a stomach suited for the diet, which also permits of a certain amount of regurgitation of food up again into the mouth, when a kind of chewing of the cud occasionally is indulged in. The stomach is large and long, resembling the colon or large intestine of the highest Mammalia in its general shape. It measured, in one instance, according to Owen, no less than three feet six inches, the measurement following its bends or curvatures. It consists of a left, middle, and right or pyloric division. The left ends in two round sacs, and these are really continuations of the stomach separated to a certain extent by a peculiar arrangement of the three bands of muscular fibres which pass separately along the organ. Numerous clusters of secreting glands are found in the mucous membrane of the stomach in its middle part, and they disappear near the pylorus where the tissues are thick and corrugated. The animal has a small intestine, a cæcum, and a large gut, but this last is not much larger than the first part of the stomach. The organs of the circulation of the blood resemble those of the other Mammalia, but there is a distinction which relates to the short period during which the young Kangaroo is a portion of the maternal being. So soon is it born, and so soon therefore must it breathe, that before the heart has grown much, it has the blood from the lungs and the rest of the body running through it. The young Kangaroo breathes when its heart is not fully developed, yet it has the perfect double circulation set up. The auricles of the heart communicate as in other Mammals until birth, but the duration of this communication is very short in the Marsupial, and its traces so evident in the other Mammals are wanting in it. The arteries of the body are simpler than in those Mammals which have a more complicated intestinal arrangement, and Owen, in his great work on the Marsupials, has pointed out that the hind limbs and tail are supplied with arterial blood by vessels which have an arrangement not without its similarity to that of birds. Leading a very simple life, and one of great sameness, moving in a manner which does not require much complexity of muscular action, the nervous system of the Kangaroo could not be expected to be highly organised or fully developed. The brain is small for the body of the animal. It is simple in form, and does not cover the cerebellum, which is visible behind, and has a little lobe on each side. The surface of the brain proper has a few convolutions on it, and more perhaps than



STOMACH OF THE GREAT KANGAROO.
(œ) œsophagus; (in) intestine.

the Rodent Mammalia have. The commissures of the brain, which relate to the complexity of the method of life, are unequally developed. The central one, or the corpus callosum, is small, and the front one is very large. Finally, the part of the brain which refers to the sense of smell is large, but hidden by the brain proper, and its nerves supply a large surface in the nose, at its upper part at the base of its skull.



BRAIN OF THE GREAT KANGAROO.

The young Kangaroo, when very small, and almost transparent, comes down from the womb into a canal, and gets into the uro-genital sac, as it is termed. Thence it is taken by the mother, and put into the marsupium, or pouch, where it fixes on to a nipple, and holds on. As the little one is ever "at the breast," it might have any quantity of milk go the wrong way, but this is provided for by the upper part of the organ of voice (the larynx) being prolonged at the back of the nose, above the level of the long nipple. Breathing goes on through the nose, and swallowing safely through the gullet.

THE HARE KANGAROO.*—THE TURATT.

There are many kinds of Kangaroos, and one of them, which is solitary and nocturnal in its habits, is called the Hare Kangaroo, of which Mr. Gould writes:—"The name of Hare Kangaroo has been given to this species as much from its similarity of form and size to the common Hare as from its similarity of habits. I usually found it solitary, and sitting alone on a well-formed seat under the stalk of a tuft of grass on the open plains. For a short distance, its fleetness is beyond that of all others of its group that I have had an opportunity of coursing. Its powers of leaping are also equally extraordinary. While out on the plains in South Australia, I started a Hare Kangaroo before two fleet Dogs. After running to the distance of a quarter of a mile, it suddenly doubled and came back to me, the Dogs following close to its heels. I stood perfectly still, and the animal had arrived within twenty feet before it observed me, when, to my astonishment, instead of branching off to the right or to the left, it bounded clear over my head, and, on descending to the ground, I was able to make a successful shot, by which it was procured. It has the end of the nose covered with a fine set of hairs. The fur is long and soft and very hare-like, and it has small limbs and sharply-pointed nails."

THE GREAT ROCK KANGAROO.

This is very different from its timid congener just described. It inhabits the sterile and rocky mountains in the south-eastern part of Australia. It scampers about the rocks, and readily escapes Dogs, and it is a dangerous and formidable animal to approach, for it will, if closely pressed, turn on its enemy, and force him over the rocks. It bites, and uses its strong fore-arms very efficiently. It is called *Macropus robustus*, and is often found in companies of four or six; and it has more powerful fore-limbs than the Great Kangaroo, which is even sometimes the smaller of the two. It has the part of the nose called the muffle without hair.

THE RED KANGAROO† is so called from the red tint of the male, which is sometimes marked under the neck and elsewhere. It was found in the plains near the Darling and Murrumbidgee rivers, and is celebrated for its great fleetness; and the female is often called the "Flying Doe." It is as fast as the Agile Kangaroo,‡ which is long-haired, and is found in Northern and Eastern Australia.

Van Diemen's Land has a Kangaroo with a long, deep-grey fur, with red on the back of the ears, neck, and shoulders; and it is called the Brush Kangaroo by the settlers. It is eaten and highly esteemed, and its skin is exported for leather. Liking the dense and damp forests of the island, it finds a safe retreat therein, and probably this is what keeps them from extinction, for they have been killed by the thousand, in order to supply contracts for boot-leather. The young of this Kangaroo,

* *Macropus leporoides* (Gould). † *Macropus rufus* (Desm.). ‡ *Macropus agilis* (Gould, sp.).

which is also called after Bennett the naturalist (*Macropus Bennetti*), does not leave the pouch of its mother permanently, until it is as large as a Rabbit.

In the north of Australia, in the region of King George's Sound, there is a small Kangaroo which is not larger than a common Rabbit, and it is a very interesting example of how species may differ from the type of a genus. It has a slender and rather short tail, which is rather scaly, and has but a few hairs on it, but it is not very short. The ears are short and round, and the hind feet are short. The departure from the configuration of the Great and Brush Kangaroo shape is therefore great. It is called the Short-tailed Kangaroo. The last four kinds mentioned are grouped together with others under a sub-genus, *Halmaturus* (ἅλμα, a leap, and οὐρά, a tail).

BRUSH-TAILED ROCK KANGAROO.

THE BRUSH-TAILED ROCK KANGAROO.

Almost as strange as the slender-tailed Kangaroo are those which are called the "brush-tailed," and which inhabit rocky situations (*Macropus penicillatus*). Mr. Waterhouse thus notices them :—

"Whilst the Kangaroos of the plain have the fore part of the body slender and light, great strength in the hinder parts, combined with a long leg and foot, adapting them to fleetness, the tail powerful, and assisting in the support of the long body, we perceive certain modifications in the form and structure of these parts in the Rock Kangaroos which adapt them to their particular habitats. The body, more compact in form, requires but little assistance from the tail for its support, the leverage being less; and the feet are, though powerful, comparatively short, and remarkably rough beneath, being thickly covered over this part with hard tubercles, which no doubt prevent the foot from slipping. The nails of the two larger toes are shorter than usual, and, indeed, in some of the species, scarcely project beyond the fleshy pads with which the toes are terminated, and on the upper surface of which the nails are placed. A long and slender foot, with long nails, as in the typical Kangaroos, it is obvious, would be ill-adapted to an animal which has to leap to and balance itself upon the small ledges of the rocks. The tail is large, but not thickened at the root, as in the plain Kangaroos; and, unlike the tail in those animals, it is clothed with long hairs, which, gradually increasing in length from the base of the tail, become very long and bushy at the opposite extremity. It serves to steady the animal in its leaps, and to balance the body when perched in situations which

require it, but is of little assistance in supporting the weight of the trunk. Its muffle, that is to say, the end of the nose, is naked, as in the scrub-inhabiting Kangaroos just noticed, and it forms the type of the sub-genus *Heteropus"* (ἕτερος, altered, πους, foot).

One of these was hunted and shot amongst the woods of Liverpool plains, New South Wales, by Sir Edward Parry, who wrote that they appear to be gregarious, and seem to prefer the neighbourhood of rocky ground, in which they had holes, and to which, when hunted, they retreated. They swarm along in groups one after the other, and jump from side to side, alighting on ledges so slightly prominent that their resting thereon appears to be an impossibility. They go into caves and holes in the rocks during the day, and they enjoy the night, and gambol and feed by moonlight.

A Rock Kangaroo, with white and black bands on it, inhabits Western Australia, and a short-eared kind enjoys the hot sands and high rocks of Hanover Bay. There is a Kangaroo in the island of New Guinea (*Macropus Brunii*), and it was the first seen by Europeans.

THE COMMON TREE KANGAROO.*

This is an inhabitant of New Guinea, and instead of frequenting the brush and scrub, which are not physical features found in the island, or the rocks, it lives in the forests, and is no mean but rather a good climber of trees. There is a Kangaroo look about the animal, even when it is seated on a thick branch, but the fur is very different to that of its fellows of Australia. The fur looks coarse and harsh, and is not very unlike that of a Bear. There is no soft under fur, but all the hairs are long and resemble the long ones of the Kangaroos, and the ears are quite clothed with it. Then, as the animal glides down the stem of a tree, the shortness of the hind legs becomes apparent; moreover, the claws on the foot do not resemble those of the Kangaroo. The feet are stout but rather short, and the toes are more equal in size than in the other Kangaroos. The claw of the outer toe is often on a line with the middle of the longest one (the fourth), whilst the nails of the double inner toe extend slightly beyond its base. The nail of this large fourth toe is about an inch in length. Then the fore limbs are nearly as large as the hind ones, and are very strongly made, and so are the hands, the claw of the middle finger being three-quarters of an inch in length. It has a clumsy-looking head, with a high muzzle and small lower jaw. The upper lip is straight. It has a large face and small ears, and the colour of the fur is brown-black and yellow-brown. The tail is very long, tapers slightly, and is considerably of use in steadying the climber, and it is carried very much after the fashion of the other Kangaroos when

COMMON TREE KANGAROO.

* *Dendrolagus ursinus* (Müll.).

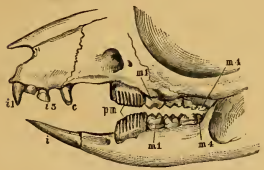
the animal has come down from its tree and hops off to its retreat. A specimen in the Zoological Gardens of London had grizzled-grey fur, whiter underneath the jaws and on the neck and limbs, and the ears were wide apart, and the powerful fore limbs ended in five claws. The tail tapered but very little. This was probably a second species called the Brown Tree Kangaroo (*Dendrolagus inustus*).

These Tree Kangaroos have a small superior canine tooth on each side, and the hinder incisor is not grooved. Hence they form a sub-genus, which is called *Dendrolagus* (δένδρον, a tree, λαγώς, a hare), Tree Hare.

KANGAROO-RAT.

THE KANGAROO-RATS.*

These are also called Potoroos, and are of small size, being about that of a Hare or Rabbit. They have a compact body, the neck being short, and the ears are rather rounded, so that their shape is unlike that of the Great Kangaroo, but it resembles that of the smaller kinds somewhat. They have a rat-like shape, both hind feet like the Kangaroos, a long tail, and peculiar teeth. The head is very like that of a Rodent, and the incisor teeth in the upper jaw have the front ones the longest. The canine teeth exist in the upper jaw, and the premolar is large, and has numerous distinct vertical grooves on the outer and inner sides; and the front molars are the largest, the smallest being in the rear. The toes of the fore foot are unevenly developed; the three central ones are large, and those at the side are small. The nails are solid, broadest above, and much compressed. The foot is long, and the fourth toe and nail are greatly developed. The fifth toe is next in size, and the small second and third are coupled together by skin, and form a projection, with two small nails, which are useful in combing and scratching the fur. The first toe is absent. The Rufous Kangaroo-Rat inhabits New South Wales, and is very common.† Its nest is made up of grasses, and is frequently placed under the shelter of a fallen tree, or at the foot of some low shrub. During the day the little animal lies curled up in its nest, but it occasionally reposes in a "seat" like the Hare Kangaroo; but it never sits in the open plains. On being pursued it jumps like a Jerboa, with great swiftness for a short distance, and seeks shelter in hollow logs and holes. Its food consists of roots and grasses. Another is a native of Van Diemen's Land, and keeps to the open, sandy, or stony forest land, rather than to the thick and humid bushes. It is called *Hypsiprymnus cuniculus*.



TEETH OF THE KANGAROO-RAT.

* Sub-genus *Hypsiprymnus*.

† *Hypsiprymnus rufescens*.

None of the animals hitherto described as Kangaroos have any prehensile power in the tail; but in one group of the Kangaroo-Rats, the tip of the tail has a brush of long hairs above, and is clothed beneath with short hairs, which are closely applied to the skin. This structure, and the motion of the muscles beneath, give the Tufted-tailed Kangaroo-Rat* of New South Wales a power of encircling and holding objects, especially for seizing grasses with which to make its nest. This is placed in a hollow in the ground, excavated for its reception, and its opening being on a level with the surrounding herbage, the practised eye of the native is required to discern it. After the little things creep in, they drag some grass after them, and close up the place. In the evening, they sally forth and scratch and dig up roots with their strong fore-claws.

THE RAT-TAILED HYPSIPRYMNUS.†

The Rat-tailed Kangaroo-Rat is about fifteen inches and a half long, and the tail measures, in addition, more than nine inches. It has a long head and rather short hind feet, and the rat-like tail has short stiff hairs on it which do not quite hide the scaly skin beneath. The body fur is long and loose, and dusky brown, more or less tinted with black and pale yellowish-brown. The end of the nose or muzzle is spotted, and the ears are short and rounded. This little animal lives in New South Wales, and was that which was first described by Hunter under the name of Potoroo, or Poto Roo, being the "Bettong" of the natives of New South Wales. The stomach of the Kangaroo-Rats is less sacculated than that of the Kangaroos, but its left-hand portion is enormously developed in proportion to the rest, and may be compared with that of the Ruminantia in point of relative size. It may be noticed that the lower jaws of the Potoroos, which are largely inflected at the angle, articulate with the skull rather differently to those of the Kangaroos. In these last, the cavity at the base of the zygomatic process which receives the lower jaw is broad and slightly convex, permitting considerable side-to-side movement which is useful in the occasional "cud chewing." But in the others the cavity barely deserves the name, it being a nearly flat surface, and, therefore, not much motion, except that of an up-and-down kind, is possible to the jaw. The organ of hearing has been slightly noticed in the Great Kangaroo in a former page, and it is necessary to observe that the tympanic bone does not form a perfect tube in the Potoroos as in the Kangaroos, and that the surface of the auditory cavity is also increased by a "bulla," or bony cavity, bulging out at the under part of the skull. Corresponding "bullæ" were noticed in the Rodentia, but in their case the swelling is in the temporal bone, whilst in the Marsupials, with the exception of the Wombat, they are formed out of the sphenoid bone (the great ala). Moreover, the Potoroos, like the Kangaroos, and some of the other Marsupials (the Phalangers and Koalas), have the ear chamber prolonged, by a number of cells, into the zygomatic process of the temporal bone. The Kangaroo-Rats are numerous, and there are many species. They are distributed in New South Wales, Western Australia, Van Diemen's Land, and South Australia, and to the north-east.

FORE (A) AND HIND (B) FOOT OF HYPSIPRYMNUS.

Sir R. Owen investigated the anatomy of a small Kangaroo-Rat which had been described by Mr. Ramsay in Australia, and which was remarkable for its musky smell. It is a long and slender-bodied little animal, measuring about one foot three inches and a half from the snout to the end of the tail, which is five inches and nine lines in the female, and rather less in the male. Its hinder legs are shorter, and the head is more slender and pointed than in the Kangaroo-Rats just described. The fur is of moderate length, pretty closely applied, and has numerous rather long hairs scattered here

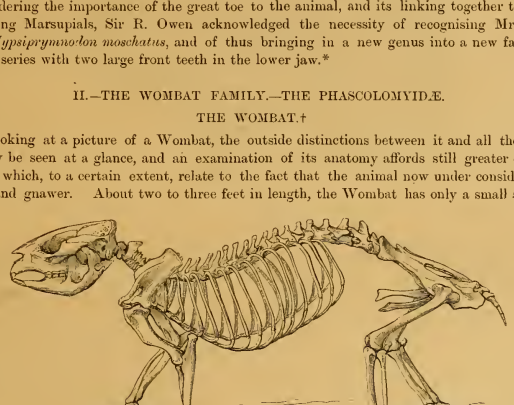
* *Hypsiprymnus penicillatus.* † *Hypsiprymnus murinus.*

and there, the visible portions being black or blackish, or pointed. These are relieved by the dark and light-barred colour of the visible part of the shorter hairs, all the hairs being of a leaden-greyish tint at the skin. The upper surface of the body has a close and stiff fur of rich golden colour, mixed with black; the head, face, and lower parts of the legs are dark brownish-grey; and there are a few patches of white along the centre of the throat and chest. The fur covers the tail for half an inch or more, and then the rest is naked, and covered with a network of scales about three to a line in length. The scales are black above, and a few minute and very short hairs project from the interstices of the scales. The animal has a naked muffle and rounded ears. The hind foot is remarkable, for whilst the skull and dentition of the creature would associate it more with the Kangaroo-Rats, the position of the first toe (wanting in the Kangaroo-Rats) resembles somewhat that of the Phalangista group, or the Phalangers, which will be noticed further on. The sole of the foot is long, and there is a nailless projecting first toe, like a thumb; next come the second and third toes—small, united by skin, and leaving the two combing-nails visible; and then the largest, or fourth toe, is followed by a smaller fifth. Sir R. Owen judged that this animal was an occasional climber of trees, but that its usual locality was on the ground. Mr. Ramsay states that it lives in the Rockingham Bay district, and that it frequents the dense and damp positions of the scrubs which fringe the rivers and clothe the sides of the coast range. Its habits are diurnal, and its movements are graceful. It procures its food by turning over the rubbish in search of insects, worms, and tuberous roots, frequently eating the palm-berries, which it holds with its fore paws, after the manner of the Phalangers, sitting up on its haunches, or sometimes digging. They have a pouch, and two young ones have been found in it. Considering the importance of the great toe to the animal, and its linking together the climbing and jumping Marsupials, Sir R. Owen acknowledged the necessity of recognising Mr. Ramsay's name of *Hypsiprymnodon moschatus*, and of thus bringing in a new genus into a new family in the Kangaroo series with two large front teeth in the lower jaw.*

II.—THE WOMBAT FAMILY.—THE PHASCOLOMYIDÆ.

THE WOMBAT.†

On looking at a picture of a Wombat, the outside distinctions between it and all the Kangaroo family may be seen at a glance, and an examination of its anatomy affords still greater evidence of differences which, to a certain extent, relate to the fact that the animal now under consideration is a burrower and gnawer. About two to three feet in length, the Wombat has only a small stump of a



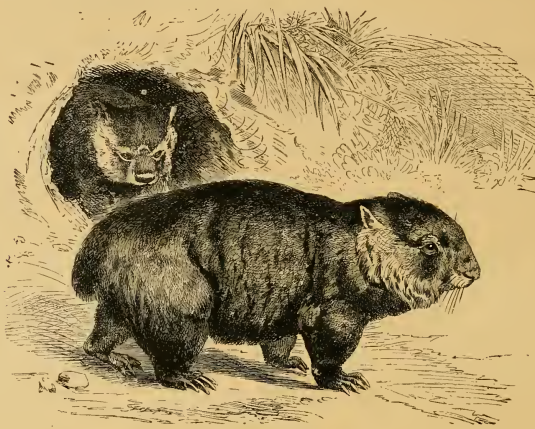
SKELETON OF THE WOMBAT.

tail, a low body, small feet, and strong limbs, ending in broad extremities, well provided with claws. It has moderately long and coarse fur of a grey-brown colour, and there is some white about the short ears, and the feet are black. It is usually a plump animal, with a bare black muzzle, and feet naked beneath, and covered with little tubercles of flesh. The claws are large, and those of the fore feet (five

* Description by E. P. Ramsay, F.L.S., and communication from Sir R. Owen to Linnean Society, London.

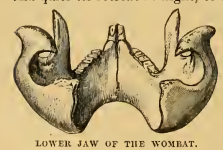
† *Phascolomys Wombat* (Peron and Lesueur). φάσκωλος, a pouch, and μῦς, a mouse.

in number) are solid and but little curved, whilst the four on the hind feet are curved and concave beneath. It has long moustache hairs, and plenty of them. Sir Everard Home had one, and he found that its principal desire was to get into the ground, and to do this it worked with great skill and rapidity, covering itself with earth with surprising quickness. It was very quiet during the day, but was in constant motion during the night; was very sensible of cold; ate all vegetables, and was particularly fond of new hay, which it ate stalk by stalk, taking it into its mouth like a Bear, in small bits at a time. It was not wanting in intelligence, and appeared attached to those to whom it was accustomed, and



WOMBAT.

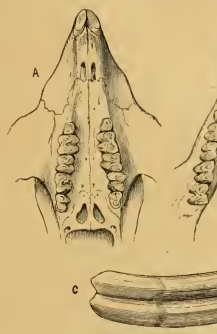
who were kind to it. When it saw them, it would put up its fore-paws on their knees, and when taken up would sleep on the lap. It allowed children to pull and carry it about, and when it bit them it did not appear to do so in anger or with violence. When wild, the Wombat hides up during the day, and quits its retreat at night, to dig and get grass and roots. It is by no means an active animal, and shuffles along like a Bear. The Wombat has a slit-like, imperfect marsupium, and the special peculiarities of its order, such as marsupial bones, the inflected lower jaw, and double uterus. On the hind foot the innermost or first toe is very small, nailless, and placed at right angles to the foot, and the second, third, and fourth toes are joined by skin, and have larger claws than the small fifth toe. The stomach is simple, and has a peculiar glandular apparatus, and the cæcum is short, and has an appendage as in man and some monkeys. The teeth are remarkable for their number in relation to those of the Kangaroos, and for having no rootlets. The incisor teeth greatly resemble those of a Rodent, like the Rat. They are two in number in each jaw, and are widely separated from the other teeth. The molars are long, curved, and, like the incisors, have no true fangs, but persistent pulps. They are divided into two nearly equal parts by a fold of the enamel entering deeply into the body of the tooth on one side, and a slight indentation on the opposite side.



LOWER JAW OF THE WOMBAT.

The number of the persistent teeth is as follows:—Incisors, $\frac{2}{2}$; true molars, $\frac{4-4}{4-4}$. It is the only

Marsupial which has an equal number of incisors in both jaws. There are no canines. As the Wombat uses much force in gnawing, the muscles of the jaws and their bony attachments are large; consequently the temporal ridges are strongly marked. There is a deep and strong zygomatic arch, and in the lower jaw the turned-in angle is of great size. The chin is also large, and the joint of the jaw also. The sutures of the bones of the skull are scarcely ever obliterated, and the auditory "bullæ" are formed in the temporal bone. With regard to the marsupial bones, they are long, flat, curved, and, moreover, less expanded near their attachment to the pubis. The ribs are fifteen in number on each side, and the collar-bones are large and stout. There is a curious power of movement of the ankle, so that the foot can imitate the turning movements of the wrist and fore-arm of man. This pronation and supination is because the small bone of the leg, the fibula, is free and not attached to the other bone (tibia), and because there is a muscle whose action is to move the fibula after the fashion of the corresponding muscle in the fore limb. The stomach is smaller than in the Kangaroos, and has a large gland.



TEETH OF THE WOMBAT.
A, Upper Jaw; B, Lower Jaw; C, Molar.

The Wombat has been found in South Australia, Van Diemen's Land, Bass Strait, and in New South Wales.

CHAPTER II.

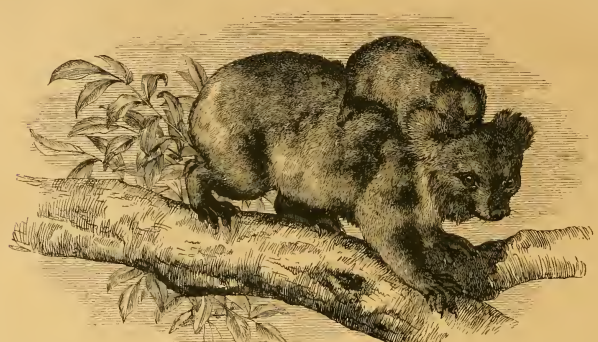
THE PHALANGER, POUCHED BADGER, AND DASYURE FAMILIES.

THE PHALANGER FAMILY—The Koala—Habits—Characteristics—The Cuscus—The Vulpine Phalanger—The Dormouse Phalanger—Habits—Remarkable Characters—The Flying Phalangers—Its Flying Machine—Habits—The Squirrel Flying Phalangers—Habits—The Parachute-like Membrane—Exciting Scene on board a Vessel—Characteristics—The Opossum Mouse—The Noolbenger, or Tait—A Curiosity among Marsupials—Distinctive Features—THE POUCHED BADGER FAMILY—Characteristics—The Rabbit-eared Perameles—The Bandicoot—The Banded Perameles—The Pig-footed Perameles—Discussion regarding it—Characteristics—THE DASYURUS FAMILY—Characteristics—The Pouched Ant-eaters—The Banded Myrmecobius—Description—Great number of Teeth—History—Food—Habits—Range—The Ursine Dasyure—Appearance—"Native Devil"—Ferocity—Havoc among the Sheep of the Settlers—Trap to Catch them—Its Teeth—A True Marsupial, though strikingly like the Carnivora—Skeletal Characters peculiar to itself—Mauge's Dasyure—The Dog-headed Thylacinus—Description—Resemblance to the Dog—Habits—Peculiarities—The Brush-tailed Phascogale—Description—Other Varieties.

III.—THE PHALANGER FAMILY.—THE PHALANGISTIDÆ.

The loftiest of the gum-trees of the country from Moreton Bay to Port Phillip, and even more widely than this, were often the familiar haunt of a small Marsupial animal, not unlike a little Bear, about two feet in length, and without a tail. It is a famous tree-climber, and its stout body, small head, short limbs, and well-developed feet, are all cased in an ash-grey fur. It has moderate-sized ears, which are hidden by the long hair of the head, and it has a short and nearly naked black muzzle. The eye is large and without eyelashes. The natives climb up the trees after it, according to Mr. Gould, with as much ease and expertness as an European would get up a long ladder, and having reached the branch, perhaps forty or fifty feet from the ground, they follow the animal to the extremity of a bough, and either kill it or take it alive. This animal is called the Koala, and it feeds

on the tender shoots of the blue gum in preference to those of any others, and it rests and feeds in the boughs. At night it descends and prowls about, scratching up the ground in search of some peculiar roots, and it seems to creep rather than to walk. When angry it utters a long, shrill yell, and assumes a fierce and menacing look. They are found in pairs, and the young soon learn to perch on the mother's shoulders. Mr. Gould says that, unlike most quadrupeds, the Koala does not flee upon the approach of man, and that it is very tenacious of life. Even when severely wounded it will not quit its hold of the branch upon which it may be. The animal has a nice thick fur, which nearly hides the ears, and the pouch is large. A careful examination of the animal shows that it differs from the Kangaroos and Wombats; it is more like the latter than the former, but it is sufficiently distinct to be placed in another family, the Phalangers, in which the incisors are six above and two below, and there are two canines in the upper jaw, and in some, two in the lower jaw, but not in all. There are two premolars above and below, and either six or eight molars in the upper and lower jaws.



KOALA.

The head is rather small, and the face is short, the upper lip being cleft. The limbs are equal; the fore feet have five well-made toes with compressed and curved claws; the hind feet have five toes, of which the first or inner one is large, nailless, and at right angles to the rest, and opposable to them. The second and third toes are shorter than the others, and are united in a common skin, and they have nails. The fourth and fifth toes are curved and have compressed claws. The name Phalangista is derived from this union by skin of the phalanges of the foot. The tail may be absent, or long, and more or less prehensile, but sometimes not.

There is a well-developed pouch, and the stomach is simple, and the cæcum is usually very long and large. One young one is produced at a birth.

The Koala, or Native Bear,* may be taken as the type of the tailless group, and it belongs to the genus *Phascolarctus*.

The Cuscus, or Ursine Phalanger,† belongs to a second division, for it has a prehensile tail. They are common animals in the dense woods of the Island of Celebes. They squat on the branches half asleep by day, but are lively enough at night, and it is said that they have a fancy for flesh as well as fruit. A pretty spotted Cuscus inhabits the islands of Amboyna, Waigeoe, Banda, and New Guinea, as well as Cape York.‡ They are dull in captivity, but when placed together they fight with fury, growling

* *Phascolarctus* (pouched-bear) *cinereus*. † *Phalangista ursina*. ‡ *Phalangista* (*Cuscus*) *maculatus*.

like Cats, and biting. They have small red eyes with a vertical pupil, short ears, and a very stupid look. They are all nocturnal in their habits, and feed on fruit, buds, leaves, meat, and eggs.

One of the Phalangers, called *Cuscus albus*, is abundant in New Ireland, Amboyna, Banda, and Timor, and is remarkable for its peculiar odour. The male is white, and the female reddish-brown in colour, both being about the size of a common Rabbit. It is slow in its movements, lives in trees, and takes good care to conceal itself, but its scent discovers it. The naturalists Lesson and Garnet stated that when they traversed the forests of the island the odour of the Cuscus was distinctly perceptible. It is stated that if these animals see any one, they suspend themselves at once by the tail, and if they are looked at steadfastly, they will drop by-and-by from fatigue, and are then easily caught; in fact, they pretend to be dead.

CUSCUS.

THE VULPINE PHALANGER.*—THE BRUSH-TAILED "OPOSSUM."

Waterhouse describes this Marsupial to be about the size of a Cat, but in shape it is somewhat between a Squirrel and a Marten. It has long and somewhat pointed ears; and the tail, clothed with bushy, harsh, black fur, except beneath, near the end, where it is naked, is about as long as the body. The limbs are rather short, the muzzle is moderately long and foxy-looking, and the whole body and head, except the naked muzzle, are covered with a grey and black fur. The moustaches are long, numerous, and black, and the feet are yellowish-white, and the naked soles are flesh-coloured, the nails being dusky. The pupil of the eye is round and intensely dark in colour. They sleep during the day, and become active during the evening, and on the alert for their food, which consists, in the Zoological Gardens, of bread and milk, fruit and vegetables. They hold up the solid food between the hands as a Squirrel holds a nut, and nibble very much in the same manner. Their native haunts are New South Wales, Western Australia, and North Australia. They inhabit the large trees, usually the Eucalypti, selecting such as have the heart of the branches or trunk decayed, and they take refuge there during the daylight. At night they leave their nests and climb the branches of the trees which yield them buds and fruit. They descend to the ground for food, and doubtless now and then eat snails and small birds. When climbing they use the tail to hold by, and carefully grasp every support with it before they let go with their feet or hands. A brown-black species, closely allied, lives in Van Diemen's Land.†

* *Phalangista vulpina.* † *Phalangista fuliginosa.*

VULPINE PHALANGER.

THE DORMOUSE PHALANGER.*

This is a very small Marsupial animal, about six inches in length, including the tail, which measures nearly, if not quite, one-half. It is like a little Dormouse, with its soft fur, ashy-grey in colour, large ears, and thick tail. They are broader, not so long in the leg, and usually larger than the Dormouse, and the eyes are larger, and the upper jaw overhangs the lower. But they look just as fat and sleepy in the daytime. The habits of these animals, moreover, are much the same, for the Phalangista living in Van Diemen's Land feeds on nuts and other similar food, which they hold in their fore paws, using them as hands. They are nocturnal, remaining asleep during the whole day, or, if disturbed, are not easily roused into a state of activity. They come forth in the evening, and are then more easy and rapid in their movements. Some of these were kept in the Zoological Gardens of London, and it was noticed that they made great use of their tail, which is prehensile, and thus not like that of the Dormouse. They ran about a small tree, using their paws and tail to hang on by, and using the tail as a suspender when they descended. Sometimes the tail is thrown in a reverse direction, and is turned over the back, and at other times, when the weather is cold, it is rolled closely up towards the under part, and coiled up almost between the thighs. They are like little balls of fur, and are very gentle and harmless.

Mr. Gould states that another kind of these Dormouse-looking creatures is very abundant in the northern portion of Van Diemen's Land, and that of all trees it appears to prefer the Banksia, whose numerous blossoms supply it with a never-ceasing store of food, both of insects and sweets. It undergoes a kind of hibernation somewhat similar to but not to the extent of that of the Dormouse.

These pretty little marsupials are remarkable by having only three true molar teeth in each jaw on both sides; but they have the usual two narrow, long, and pointed incisors in the lower jaw. The auditory bullæ on the base of the skull are large, and the hard palate has four openings in it. The lower jaw is slender behind, and the angular process is inflected, the process of bone being, however, slender and pointed. Their mouse-like shape is evident, but they have a large eye, and the ears are often more or less crumpled and pendent, but they start up and are erect at the least noise. There are three species of these Phalangistidæ, and they are included in a sub-genus, Dromicia. They live in Van Diemen's Land, Western Australia, and South Australia. Some which were found in King George's Sound district live in retreats under the dead bark of trees, and in holes in trees which have been burnt out.

* *Phalangista Nana.*

THE FLYING PHALANGERS.

The next genus of the family Phalangistidæ contains the Flying Phalangers, which form the genus Petaurus. They have all the peculiarities of the Phalangers, and also a skin on the flank of the body, which is extended between the fore and hind legs, which serves to sustain the animal in the air, when descending from a height. They have a long hairy tail. The Yellow-bellied Flying Phalanger (*Petaurus australis*, Shaw) may be taken as the type of the genus, and is fourteen inches long in the body, and nineteen in the tail. The peculiar fold of fur, which is its flying machine, is attached to the fore leg as far as the elbow, and all down the legs to the great toe. It is common in all the brushes of New South Wales, particularly those along the coast from Port Phillip to Moreton Bay. Mr. Gould states, in addition to this, "In these vast forests, trees of one kind or other are perpetually flowering, and thus offer a never-failing supply of blossoms, upon which the animal feeds. The flowers of the gum-trees, some of which are of great magnitude, are the principal favourites, and, like the rest of the genus, it is nocturnal in its habits, dwelling in holes of trees and in the hollows of branches during the day, and displaying the greatest activity at night, while running over the small leafy branches, sometimes even to their very extremities, in search of insects and the honey of the newly-opened blossoms. Its structure being ill-adapted for terrestrial habits, it seldom descends to the ground, except for the purpose of passing to a tree too distant to be attained by springing from the one it wishes to leave. The tops of the trees are traversed at a pace and with as much ease as if it were on the ground. If chased, it ascends to the highest branches, and performs enormous leaps, sweeping from tree to tree with wonderful address."

A slight elevation gives its body an impetus, which, with the expansion of its membrane, enables it to pass to a considerable distance, always ascending a little at the extremity of the leap. By this ascent the animal is prevented from receiving the shock which it would otherwise sustain.

THE SQUIRREL FLYING PHALANGER.*

This little creature, called the Sugar Squirrel by the colonists, is very generally dispersed over the whole of New South Wales, where, in common with other Phalangers, it inhabits the magnificent gum-trees. Mr. Gould states that it is nocturnal in its habits, and that it conceals itself during the day in the hollows of trees, where it early falls a prey to the natives, who capture it both for the sake of its flesh and skin, which latter, in some parts of the colony, they dispose of to the colonists, who occasionally apply it to the same purposes as those to which the fur of the Chinchilla and other animals is applied in Europe. At night it becomes extremely active in its motions. It prefers those forests which adorn the more open and grassy portions of the country rather than the thick brush near the coast. By expanding the membrane attached to the sides of its body it has the power of performing enormous leaps. They have the power of changing their course to a certain extent when descending, parachute-like, from a height. It is stated that a ship sailing off the coast had a Squirrel Petaurus on board which was permitted to roam at large. On one occasion it reached the mast-head, and as the sailor who was sent to bring it down approached, it made a spring from aloft to avoid him. At this moment the ship gave a lurch, which, if the original direction of the little creature's course had been continued, must have plunged it in the sea. All who witnessed the scene were in pain for its safety; but it suddenly appeared to check itself, and so to modify its career that it alighted safely on deck. This kind is not more than eight or nine inches in length, and its bushy tail is as long as the body. The soft fur of the tail, like that of the body, is a delicate ashy-grey. There is a long stripe of black fur from the naked tip of the nose to the root of the tail, and the cheeks are white with a black patch; the flank membrane is edged with white, and this is the colour of the underneath part of the body; the ears are long, and of a brownish flesh colour.

Another kind, with a yellow flank membrane, is short-headed, and it inhabits Port Essington, North Australia,† whilst the true Short-headed Flying Phalanger is found in New South Wales.‡ Probably it is the first of these which is found in New Guinea, and which has been called the Squirrel Flying Phalanger by mistake. These Flying Phalangers all have long and nearly naked ears,

* *Petaurus sciureus* (Shaw). † *Petaurus ariel*. ‡ *Petaurus breviceps*.

SQUIRREL FLYING PHALANGER.

and the side membrane extends to the outer finger. They have the outer two fingers of the hand long and equal to each other, or very nearly so; the second and third fingers are distinctly shorter than these; and the inner finger is very short. Their dentition is—Incisors, $\frac{6}{2}$; canines, $\frac{1-1}{0-0}$; premolars, $\frac{3-3}{4-4}$; true molars, $\frac{4-4}{4-4} = 40$. The incisors of the lower jaw are, as usual, long and pointed, and almost horizontal, whilst the upper incisors are large and dilated, so far as the anterior ones are concerned, and the next is smaller than the hindmost. The canine is large, and separated from the first premolar, which is large and compressed, and all the molars have rounded tubercles on them.

The Opossum Mouse * of the colonists of New South Wales used to be common in the neighbourhood of Port Jackson. It is about the size of a common Mouse, and of an ashy brown and grey colour on the upper parts and on the flank membrane; the rest is white. It belongs to the Flying Phalangers, but its side membrane scarcely extends to the wrist, and the thumb of the hind foot is large. It has only three true molars in each jaw on both sides, and the canine is close to the incisors. It forms part of the sub-genus Acrobata, whilst those already mentioned constitute the sub-genus Belideus (*βέλος*, a dart). Finally, the short-eared, white-bellied Taguan Phalanger of the scrub of New South Wales is the type of the sub-genus *Petaurus*.

GENUS TARSIPES.—THE NOOLBENGER, OR TAIT.†

This is an Australian curiosity amongst the Marsupials, and is a small, mouse-like thing, with a long muzzle, small ears, long tongue, and very few teeth. Its dental formula is—Incisors, $\frac{2-2}{?}$; canines, $\frac{1-1}{0-0}$; molars, $\frac{3-3}{2-3}$. The fore and hind extremities have toes something like those of the Lemur, called Tarsius (Vol. I., page 248). The fore feet have five smallish toes, each thickened at the end, and a minute scale-like nail, which reaches neither the end nor sides of the toe. The hind feet have five toes on each, and the innermost has the formation of a thumb, and is slender and nailless. The second and third toes are very short, and are joined to the end and furnished with small pointed nails, which are directed upwards almost at right angles to the plane of the toe; and the fourth toe is twice as long as the second and third. The fifth is shorter than the fourth, and

* *Petaurus pygmæus.* † *Tarsipes rostratus.*

has a scale-like nail on the upper surface. This is the case with the fourth also. There is a long, slender tail. The small bones of this little honey-sucker are very thin, and the lower jaw has two slender and almost straight sides, and the inflection is wanting.

This little animal is rare, but it is to be found in West Australia, from Swan River to King George's Sound. It is nocturnal in its habits, and catches flies in captivity with great ease. But its food is honey, which it gets like a moth, with its tongue. The tail is prehensile, and the little pouch contains four mammæ in the female.

The little Tarsipes, with its honey and insect diet, has a very long intestine and no cæcum, whilst the Koala has a cæcum more than three times the length of its body. The pigmy Acrobata has this organ disposed in a spiral curve in the left lumbar region. The marsupial bones are large in the Koala, and are long, broad, and flat, almost equalling the iliac bone in size. Finally, with regard to the parachute-fold of skin on the flanks of the Petaurists, it is a simple fold with very elastic tissues within, which draw it up to the body, more or less, when the animal is walking or standing. When, however, the limbs are extended after a jump, the membrane becomes very tense, and acts by increasing the surface of the body so as to oppose gravitation by the supporting power of the air.

IV.—FAMILY PERAMELIDÆ.—POUCHED BADGERS.

This group of Marsupials embraces two genera, Perameles and Chœropus, the first having several species and the last but one. They have all long, slender heads; large, long ears, with fleshy lobes; longer hind than fore limbs; the tail short in some, long in others, and hairy; and the pouch is directed backwards. They have a considerable number of teeth, there being ten incisors in the upper jaw and six in the lower; there are two canines in each jaw, three premolars in each jaw on either side, and four true molars behind them, making forty-eight teeth in all. The teeth have fangs, the premolars are compressed and pointed, and the molars have tubercles on them. The stomach is simple.

GENUS PERAMELES (BANDICOOTS).—THE RABBIT-EARED PERAMELES.*

The so-called native Rabbit of the Swan River district of Western Australia is abundant in the grassy country in the interior; and it frequents, in pairs, places where the soil will permit of burrowing. It is about the size of a common Rabbit, and has a long and pointed muzzle, which is naked at the tip. It has long, oval ears, which are tubular at the base. The eye is small, and the tail is a little shorter than the body. The legs are longish, and the fur is well grown.

This sharp-looking animal lives upon insects, and its favourite food is a large grub, probably the larvæ of a species of Buprestis beetle which infest the roots of the acacia trees. In order to obtain this peculiar food, it has to compete with the natives, who like it also, and often enough it has to rush to its long and deep burrows for safety. Its flesh is sweet, and is much sought after by the aborigines. One which was kept at the Zoological Gardens was very active in the evening, but usually slept during the day-time, when, sitting upon its haunches, with its head thrust between its hind legs, it appeared like a ball of fur. It was a very savage animal, and bit severely, holding on, moreover, if it could, with its teeth. It waddled on its hind legs alone, which were straddled, and the tail assisted in supporting the body. They have five toes to the fore-foot, of which the two outermost are rudimentary and nailless, the remaining three are well developed, and are furnished with strong solid nails, which cover the last phalanges which are cleft above in the longitudinal direction almost to the root. The hind feet have a rudimentary inner toe, the second and third are joined and are slender, and have two hollow nails, and the fourth is large and, like the fifth, which is well developed, has a solid nail sheathed on the end bone.

GUNN'S PERAMELES.—THE BANDICOOT.†

This is the animal which has given the native name to the genus, and Mr. Gunn, who discovered the species, informed Mr. Waterhouse that it is common in many parts of Van Diemen's Land, going by the name of Bandicoot. It is a burrower, and lives principally upon roots, and it likes the bulbs

* *Perameles lagotis.* † *Perameles Gunnii.*

which are introduced from the Cape and elsewhere into gardens. It is about sixteen inches long, and has a slender muzzle, moderate-sized ears, and the under parts of the body are white, the rest being grey and pencilled with black and yellow, except behind, where it is blacker. There are four broadish white bands on this part.

THE BANDED PERAMELES.*

This is a pretty little Perameles with a body about a foot in length, and a tail of about four inches long. It has rather a sharp and long snout, rather large ears, which are broad at the base, and long and pointed at the tip. The fur is longish and harsh, and is pencilled with black and yellow in about equal proportions on the upper part of the body, there being a black ground colour on the hinder part of the back. There, however, there are three broad yellow-white bands, the foremost of which crosses the back. The feet and under parts are white, and the tail is of the same colour underneath, but

BANDED PERAMELES.

black on the top. The feet are slender, and the hind ones have a rudimentary inner toe, naked beneath, in front, and at the heel. In the skeleton this inner toe has one or two phalanges, and a small tubercle without a nail is visible before the flesh is removed. It inhabits Southern Australia from east to west. This kind resembles the Bandicoot of Van Diemen's Land on the other side of Bass Strait, and may be considered its representative. It is smaller than the Van Diemen's Land species, but its tail is longer; moreover, the ear exceeds those of the insular forms in size. Like the other Perameles, the pouch for the young opens backwards. "Though provided with strong claws it rarely burrows," says Mr. Krefft, "and it is a great enemy to little Rodents. It tumbles the Mice about with its fore paws, breaks their hind legs, and eats the head."

New Guinea contains a short-legged Perameles,† which appears to be deficient in the usual number of upper incisor teeth; and another ‡ resembling the common Bandicoot.

GENUS CHŒROPUS.—THE PIG-FOOTED PERAMELES §

A very rare little, large-eared, small-legged animal was found by Sir Thomas Mitchell on the banks of the River Murray, and its appearance was so remarkable that much attention was paid to its

* *Perameles fasciata.* † *Perameles doreyanus.* ‡ *Perameles moresbyensis* (Rams.).
§ *Chœropus castanotis*—χοῖρος, a hog; and πούς, a foot.

anatomy, whilst unfortunately nothing particular was learned regarding its natural history and habits. Subsequently the little creature, whose body is about nine inches and a half long, the tail measuring in addition about four inches, was found in the interior of the country near the Swan River. It is an active little animal, and a hunter of insects, but it will feed upon vegetable substances also. Mr. Gould states that, like the Perameles, to which it is allied in many parts of its construction, it forms a nest composed of leaves and other substances. The pouch is deep and runs upwards, and not like that of the Kangaroo, and there are eight teats. At first there was much discussion whether the animal had a tail, but there is no doubt about its possessing one when in the perfect condition. The slender fore limbs, no thicker than goose-quills, end in two very small digits, and they are provided with small, compressed, and but little curved nails. They have a small fleshy pad on their under surface, behind which is a smaller one. The hind legs are longer than the front ones, and are almost as slender. The foot is long, and at first sight appears to have only one large toe, for the others are very small and far removed from the end of the foot. The outer little toe has a small nail, and the inner toes, joined, are almost as small, but they have hollow nails. The greatly-developed toe has a conical and compressed nail, but beneath there is a large fleshy pad; the rest of the foot is hairy. Hence it appears that the heel is not put to the ground. The colour of the long, loose, soft fur is brown-grey above, and yellowish-white beneath, the limbs and the fore feet have a whitish tint, and the large toe is of a dirty white colour. So far as the skull and teeth are concerned, the little Chœropus greatly resembles the other kinds of Marsupials which are classified under the genus Perameles. Sir Thomas Mitchell noticed the broad head and very slender snout, which, he stated, resembled the narrow neck of a wide bottle, in the specimen which the natives took from a hollow tree after chasing it on the ground. In the construction of the skull and in the number of the teeth, this long-eared creature resembles the rest of the genus Perameles. In the upper jaw there are five incisor teeth on each side, and they are close, and the canine is small, and resembles a premolar, and is slightly distant from the incisors. The first premolar is separated from the canine by a space of one line and a half, and slightly from the second premolar; and the second and third premolars and the four molars form a continuous line.

V.—THE DASYURUS FAMILY.—DASYURIDÆ.

These animals are all carnivorous, and prey upon small quadrupeds and the young of large ones, as well as upon birds and insects. They are of different shapes and sizes, according to the genera to which they may belong; and whilst some resemble the Shrew Mice somewhat in outward appearance, others are like the Marten, and one important group may be compared with Short-legged Wolves, or Jackals. Varying in size from that of a Mouse to a small Wolf, the members of the different genera of this family are equally variable in the number of the teeth, of the claws, and in the development of the marsupial pouch and its bones. They all have rather long muzzles and furry tails, which, however, are not prehensile. The second and third toes of the hind feet are disunited and well developed, and the thumb-toe is small or absent. There are eight incisors in the upper jaw, and six in the lower.

GENUS MYRMECOBIUS.—THE POUCHED ANT-EATERS.*

The Banded Myrmecobius may be taken as an example of this genus. It is about the size of a Rat, but it is more Squirrel-like in shape, and has a long and pointed muzzle. The tail is long and furry, with long hairs also; and the prevailing colour of the body is reddish, but posteriorly it becomes dark or black. There are nine bands of light or white colour on the sides of the body, from the back over the flanks, and the crupper is also marked with a band. The head is long, the ears are moderately long, narrow, and pointed, the gape is considerable, and the small pointed snout has some rather long smellers; there are also some long hairs under the eye. A black mark runs on the cheek to the ear, and has white hairs above and below it. The fur is somewhat remarkable. The under hair is scanty and whitish-grey, and the upper hair is rather coarse, short, and depressed on the fore parts of the body. It is long on the hind and under parts, and the hairs on the fore part of the back are black near the skin and reddish at the tip. The fur of the head is short and brownish above, being composed of

* *Myrmecobius fasciatus*—μύρμηξ, ant; βίος, life.

a mixture of black, fulvous, and a few white hairs. The fore legs are rather stout and strongly made, and the five curved and compressed claws are admirably adapted for its method of life, which consists of insect-hunting by digging. The hind limbs are suited to support the weight of the animal, as it scratches with the fore feet, but they are deficient in the first toes. The whole animal is about seventeen inches long, seven inches being included in the tail. This animal has a greater number of teeth than any other Marsupial, and, indeed, they are only surpassed by some Cetacea and Edentate Ant-eaters amongst the other Mammalia. There are fifty-two teeth in the mouth—namely, eight upper and six lower incisors, four canines, six compressed false molars behind the canines above and below, and ten small true molars above, and twelve below. The canines of the lower jaw are incurved, and the last lower molars are worn in ridges internally. The number of teeth appears, however, to be variable, and some have fifty-four and others less than fifty.

The Myrmecobius, although it has the inflected condition of the lower jawbone and small marsupial bones, not more than half an inch in length, has no pouch. The young adhere to the mother's nipples, and are protected by the comfortable fur and long hair of her body.

The Banded Myrmecobius was first discovered by Lieutenant Dale, who procured a specimen whilst on an exploring expedition into the interior of the Swan River Settlement, about ninety miles to the south-east of the mouth of the river. Two specimens of this very elegant little animal were seen by Lieutenant Dale, both of which fled to hollow trees for shelter upon being pursued. The district in which they were found abounded in decayed trees and ant-hills; and, from some peculiarities in the dentition of the animal, combined with its extremely long and slender tongue, it became evident that its food was insects, and the softer and smaller species, for procuring which, by scratching up the earth, the strong fore feet and claws appeared to be adapted. Indeed, the peculiarities of structure, combined with the fact that the animal was found in the vicinity of ant-hills, suggested that its food, in all probability, consisted chiefly of Ants: and hence the generic name. As yet, however, we have no direct evidence that Ants form the chief food of the Myrmecobius, though it is stated, in Mr. Gould's "Mammals of Australia," that wherever this animal takes up its abode, there Ants are found to be very abundant. In the same work the following particulars of the habits of the animal are given from the pen of Mr. Gilbert:—

"I have seen a good deal of this little animal. It appears very much like a Squirrel when running on the ground, which it does in successive leaps, with its tail a little elevated, every now and then raising its body and resting on its hind feet. When alarmed, it generally takes to a dead tree lying on the ground, and before entering the hollow, invariably raises itself on its hind feet to ascertain the reality of approaching danger. In this kind of retreat it is easily captured; and when caught, is so harmless and tame as scarcely to make any resistance, and never attempts to bite. When it has no chance of escaping from its place of refuge, it utters a sort of half-smothered grunt, apparently produced by a succession of hard breathings.

"The female is said to bring forth her young in a hole in the ground or in a fallen tree, and to produce from five to nine in a litter. I have not myself observed more than seven young attached to the nipples." It is not nocturnal in its habits.

With regard to the range of the genus Myrmecobius, Mr. Gould states that it is very generally dispersed over the interior of the Swan River Settlement, from King George's Sound on the south to the neighbourhood of Moor's River on the north, and as far westward as civilised man has yet been able to penetrate. Its species are also found near the Murray and Darling.

This many-toothed Ant-eating Marsupial has always been interesting to geologists, for in the Stonesfield slates of the Oolitic formation of England, which lie low down in the Great Oolite, the lower jaws of an animal have been found greatly resembling those of Myrmecobius. The fossil Amphitherium has the jaws but slightly inflected, and is not without resemblance to insectivorous creatures; but, nevertheless, its similarity to Myrmecobius struck Owen and Lyell many years since.

GENUS DASYURUS.—THE URSINE DASYURE.*

Being a great enemy of the poultry and tender rearlings of the colonists of Van Diemen's Land, this small creature has earned the name of the "Native Devil." It may be compared to a Bear, with

* *Dasyurus ursinus.*

a body about two feet in length, and the resemblance is tolerably correct in the fur, general proportions of the body and limbs, and also in its gait and its actions. The Dasyure, however, has a longer tail than the Bear, and never grows larger than a Badger. It is a short animal, with a round broad head and rather a long snout, and the coarse black fur (brown-black on the head, tail, and beneath) is marked by one broad white band across the chest and by another over the back, close to the tail. The tail is about half the length of the head and trunk. Harris notices that these animals were very common on the British first settling at Hobart Town, and were particularly destructive to poultry, and Mr. Gunn states that they commit great havoc among Sheep, and that notwithstanding their comparatively small size, they are so fierce that they are a match for any ordinary Dog.

As the settlements increased in Tasmania, and the ground became cleared, the animals were driven from their haunts near the town to the deeper recesses of the forests yet unexplored. They were easily procured by setting a trap in the most unfrequented parts of the woods, baited with raw

DASYURE.

flesh, all kinds of which they will eat indiscriminately and voraciously. They also, it is probable, prey on dead fish and blubber, as their tracks are frequently found on the sands of the sea-shore. In a state of confinement they appear to be untamably savage, biting severely, and uttering at the same time a low yelling growl. A male and female which Mr. Harris kept for a couple of months, chained together in an empty cask, were continually fighting. Their quarrels began as soon as it was dark, as they slept all day, and continued throughout the night almost without intermission, accompanied by a kind of hollow barking, not unlike that of a Dog, and sometimes a sudden kind of snorting, as if the breath were restrained a considerable time and then suddenly expelled. They frequently sat on their hind parts, and used their fore paws to convey food to their mouths. The muscles of the jaws were strong, and they crushed the largest bones asunder with ease.

This Dasyure, like the others of the genus, has the incisor teeth equal, and there are eight of them in the upper jaw and six in the lower. The four canines are large, and there are two powerful premolars in each jaw and on each side. These are succeeded by four molars above and below, and on both sides of the mouth.

The incisor teeth, equal in size, are arranged in a semicircle in the upper jaw, and those of the lower jaw have a corresponding direction, but they are rather the stouter. The canines are well developed, and those of the lower jaw bite in front of those of the upper. They look eminently

adapted for stopping and seizing prey, and their carnivorous character is surpassed by that of the premolars and true molars. These last have a triangular grinding surface: the first has four sharp cusps, the second and third have five, and the last, which is the smallest in the upper jaw, has only three. In the lower jaw the last molar is of the same size as the last but one, and has four cusps; and the other molars have much resemblance to those in the upper jaw.

The hind feet have the toes separate and not united by a fold of skin, and there is a rudimentary great toe in this species. The condyle of the humerus is not perforated—as in the Kangaroos, for instance—for the passage of the blood vessels, but is whole, and the outside of the bone is marked by a groove, along which they pass.

TEETH OF THE DASYURE.

Although this Dasyure has the lower jaw inflected, and is a true Marsupial, the resemblance in shape, and in dental and other characters, as well as in its habits, to the Carnivora is striking. Its fierce character and the nocturnal habits add to the similarity; but there are some very peculiar anatomical distinctions. The wrist bones, called scaphoid and lunar, those which are nearest the radius along the first row of carpal bones, are separate in the Dasyure, but in the Carnivora they are united to form one bone. And in the foot there is a peculiarity: for whilst in the Carnivora there is a groove between the heel bone and the astragalus, this is absent in the Marsupial Carnivore, and the articular surface of the bones is continuous.

The Dasyures have a small crest of bone on the top of the skull, which is also seen on a grander scale in the Carnivora. They have, moreover, the zygoma well developed and strong; it bulges outwards and curves upwards, but not to the amount seen in the true Carnivora. The occipital bone is developed as in the non-Marsupial mammals, but its parts, instead of joining together and forming one with age, often remain separate; but this does not appear to occur in all the species of the genus, for Owen, in his wonderful article on the Marsupials in the "Cyclopædia of Anatomy and Physiology," notices that in the little *Dasyurus Maugei* the occipital bone presents the usual state of bony confluence. He notices that the Dasyure, in common with some other Marsupials, has the temporal bone permanently divided into its several parts, there being separate squamous, petrous, and tympanic bones; but the petrous and mastoid parts are usually united. This is a reptilian peculiarity, but the tympanic bone of the Dasyure is not without its resemblances to those of birds. The surface on which the lower jaw moves or is hinged, is not composed entirely by the temporal bone, but the malar bone is slightly included, and even the sphenoid comes into the joint.

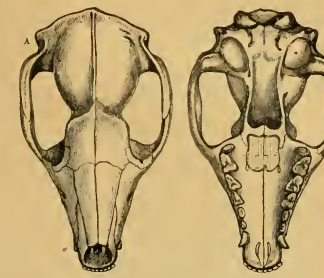
BRAIN OF THE DASYURE.

Another marked character of the Dasyures is, that their hard palates are not whole, but have spaces and perforations, and this denotes a low organisation. This absence of a perfect hard palate is seen in other Marsupials, and especially in the Bandicoots (Perameles).

The angular process of the lower jaw, where inflected or bent in, is triangular and directed upwards, with a blunt point; and the condyle of the jaw is low, being on a level with the molar teeth.

It is remarkable that the Dasyures should have the bones of the leg, the tibia and fibula, so connected together as to allow of a certain degree of rotation on each other, after the fashion of the fore-arm bones. The muscles of the leg are modified for the purpose. This interesting anatomical point recalls one of the great distinctions between the fixed leg bones of man and those of the hand-footed Ape. It is not found, however, in the non-Marsupial mammals, whose habits of life are simulated by the Dasyure; but it is found in the Wombat, a burrower, and in the Koala, Phalangers, and Opossums, which are climbers. In examining the stomachs of the Marsupials, Owen noticed that differences in food and habit are not met by alteration in the shape of the organ, as they are in the higher Mammalia. Thus, the common Dasyure, the insectivorous Bandicoot, and the leaf-eating

Phalangers, have a full round, oval, or sub-triangular-shaped stomach, with the right extremity projecting beyond and below the pylorus. The length of the stomach seldom exceeds the height by more than one-third. No cæcum is found in the carnivorous Marsupial, and the intestine is short and wide, being continued, like the intestine of a reptile, along the margin of a single and simple mesentery, from the pylorus to the rectum (Owen). The liver has a gall-bladder in the Dasyure, and there is a pancreas as well as a spleen. The heart is contained in a slight pericardium, as in the other Mammalia. The Ursine Dasyure is found in Van Diemen's Land only.



UPPER (A) AND UNDER (B) VIEW OF SKULL OF DASYURE.

There are several kinds of Dasyure, which have been carefully noticed and described. One is called the Long-tailed or Spotted Dasyure,* and is about the size of a Cat. The fur is reddish-brown, pencilled with yellow, and is spotted with white both on the body and on the tail. It has a tail as long as the head and body together, and the under parts of the body and the fore-legs and feet are of a dirty yellow tinge. It lives in Van Diemen's Land, and was, from its shape, at first called a Marten. The teats are six in number, three on each side, and seated within a slight fold only of the skin, so that there is no true pouch.

MAUGE'S DASYURE.†

This is a small animal, not larger than a half-grown Cat. It has a longish bushy tail, a broad head, and is somewhat of greyish-yellow colour. There are white spots on the sides of the body and tail. In confinement this little creature is torpid by day, but lively as evening comes on, and it rushes about, with its tail extended, with great rapidity. It is very injurious to the poultry when in a wild state, and is called the Wild Cat in Van Diemen's Land. A variety of it is the Viverrine Dasyure, which has the head and body spotted with white, the general colour being brown, black, or grey, tinted with yellow, the under parts being white. It has long hairs to its tail; rather large ears, the flesh of which is of a pale pink, as is that of the naked lips, the tip of the nose, and the soles of the feet, the latter being hairless, but covered with small fleshy tubercles. There is no trace of an inner toe to the hind foot, unless it be a slight swelling of the flesh, marking the situation of the rudimentary bone beneath. Both of these animals are to be found in New South Wales and Van Diemen's Land.

The rest of the Dasyures are widely spread over the continent. The smallest kind is the North Australian Dasyure. Geoffroy's Dasyure, which has a thin tail and an inner toe to the hind foot, inhabits Western and Southern Australia and New South Wales, is a great killer of the Yellow-crested Cockatoo, and they hunt and kill Mice or Rats as well as any Cat. They have not a pouch.

GENUS THYLACINUS.‡—THE DOG-HEADED THYLACINUS.§

This is a Dog-like, slim, narrow-muzzled animal, with clean and rather short limbs, a foxy head, and a tail about half as long as the body, which in males is forty-five inches in length. It is about the size of a Jackal, and the fur is short, but rather woolly and greyish-brown, faintly suffused with yellow in colour. The fur on the back is deep brown near the skin, and yellowish-brown towards the tip. It has from twelve to fourteen black bands on the body, and the tail has long hairs at the tip only. The eyes are keen, large, and full, and they are black and have a nictitating membrane.

* *Dasyurus macrurus*, or *maculatus*.
† *Dasyurus Maugei* (Geoffroy).
‡ θύλακος, a pouch.
§ *Thylacinus cynocephalus*.

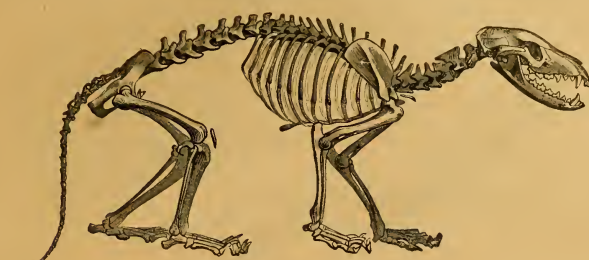
The animal walks half on its toes and half on its soles or palms, and thus is a semi-plantigrade, the body being brought nearer the ground than that of the Wolf in running. There is a marsupial pouch, but the bones are mere cartilages. The Dog-headed Thylacinus, or the Zebra-Wolf of the colonists of Van Diemen's Land, thus described, has often been taken for one of the Carnivora, and certainly there are great resemblances between it and the Dogs. The canine teeth are of large size, but they are recurved at the top, and in the upper jaw are separated from the incisors by a space, into which the point of the lower canine fits when the jaws are closed. This is different in the Dogs,

DOG-HEADED THYLACINUS.

whose lower canine passes on the outer side of the upper one when the mouth is closed. The premolar of the Thylacinus has a small cusp behind, but in the lower jaw the premolars are isolated, and do not form a continuous cutting and masticating ridge. It is also to be remembered that this animal has a peculiar lower jaw, as it is one of the Marsupials, and the angle is inflected. It is a Marsupial, with some structures which foreshadow those of the more highly-developed Dog.

Mr. Harris, who was the first to make this animal known, states that it lives among caverns and rocks, in the deep and almost impenetrable glens, in the neighbourhood of the highest mountains of Van Diemen's Land. The specimen from which his description was taken was caught in a trap baited with Kangaroo's flesh; it remained alive but a few hours, having received some internal hurt whilst being secured. From time to time it uttered a short guttural cry, and it appeared exceedingly inactive and stupid, and, like the Owl, had an almost continual motion of the nictitant membrane of the eye. Remains of an Echidna were found in the stomach of the animal. Waterhouse states,

on the authority of Mr. Gunn, that these animals are common only in the remoter parts of the colony, and used to be frequently caught at Woolnooth and the Hampshire Hills. They attack the Sheep at night, but are occasionally seen during the daytime, upon which occasions, perhaps from imperfect vision, their pace is very slow. Mr. Gunn also observes that the Thylacinus sometimes attains so large and formidable a size, that a number of Dogs will not face it. That gentleman denies that the



SKELETON OF THE DOG-HEADED THYLACINUS.

tail of the animal is compressed, as has been stated by some authors, and his observations do not confirm the aquatic habits which have been attributed to it. There are cartilages in the place of the marsupial bones; but the pouch is well developed in the female Thylacine, and there are four well developed teats, each four inches long, indicating that it may contain four young ones at a time. The marsupium, or pouch, opens backwards, not, as in the Kangaroos and most others, forwards.

GENUS PHASCOGALE (POUCHED WEASELS).—THE BRUSH-TAILED PHASCOGALE.*

This genus includes many species of small Weasel- or Rat-like Marsupials. They are small, insectivorous, and climb shrubs and trees in pursuit of their prey. The largest known is about the size of a common Rat. The brush-tailed kind inhabits New South Wales, South Australia, and Western Australia, and is a pretty little animal, having a long and soft fur, of a grey colour above and white or yellow-white under the body. The eyes are encircled with black, and there is a pale spot above and below the eye, and the hairs are blackest along the middle of the head. The ear is rather large and not furry; the tail is about equal to the body in length, or seven inches to nine inches, and there is a portion near its end of about two inches in length, which is clothed with short, stiff hairs, and the rest has long and glossy hairs, sometimes an inch or two long. An insectivorous little creature, its teeth are modified to meet its diet, and they are less carnivorous than the other Dasyurids. They have the two foremost incisors of the upper and lower jaw larger than the others. There are three premolars in each jaw on each side, and eight molars above and below, which are studded with prickly tubercles, those of the upper jaw having triangular crowns. There are five toes to the fore and hinder extremities, and the inner toe of the latter is in the form of a small nailless prehensile thumb. The brain-case is large and the skull comparatively smooth. The species just noticed is said to enter the stores of the settlers, and it makes a nest in the hollows of the trunks of trees or in the branches. The female has no pouch, but ten teats covered with hair. It is the Tapoa Tafa of White, according to Krefft.

Another species, about six inches long, not including a tail of three inches—the Freckled Phascogale—lives in the Swan River district and at King George's Sound, being generally distributed over Western Australia. It has the fur freckled with black and white on the head and fore parts of the body. Mr. Gilbert found insect remains in its stomach, and he obtained a female specimen having

* *Phascogale penicillata.*

BRUSH-TAILED PHASCOGALE.

seven young attached. They were little more than half an inch in length, and quite blind and naked. Above the teats of the mother is a very small fold of skin, from which the long hairs of the under surface spread downwards, and effectually cover and protect the young. This fold is the only approximation to a pouch which has been found in any species of this genus. The young are very tenacious of life, and those just mentioned lived nearly two days attached to the mammæ of the dead mother.

The Yellow-footed Phascogale is a kind which inhabits New South Wales and South Australia, and the White-footed Phascogale and a closely-allied kind live in South Australia and Van Diemen's Land. In New Guinea, which constitutes a part of the Australian natural history province, there is a black, short-eared, and short-furred kind, about the size of a Rat, called *Phascogale melas*.

ANTECHINUS.

OPOSSUM AND YOUNG.

There is a little kind, measuring only three inches in length, with white fur everywhere, except on the upper parts, which are ashy grey; and in Western and Southern Australia there is one which has great ears, very slender limbs, and a short and thick fat tail. It looks like a large-eared, fat-tailed Mouse, and is under four inches in length. All these kinds of Phascogale, except the brush-tailed one, belong to a group with very short hairs on the tail, and are sometimes classified under the name Antechinus, the thick-tailed one being termed Podabrus; and they all have shallow pouches.

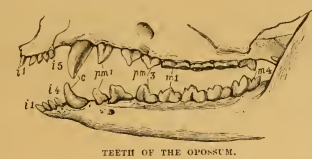
CHAPTER III.

THE OPOSSUMS.

Prehistoric Opossums—Description of the Animal—Their Teeth—Habits—THE COMMON OPOSSUM—D'AZARA'S OPOSSUM—THE CRAB-EATING OPOSSUM—THE THICK-TAILED OPOSSUM—MEBIAN'S OPOSSUM—Pouchless Opossums—Their Young—THE MURINA OPOSSUM—THE ELEGANT OPOSSUM—THE YAPOCK—Classification of Marsupial Animals—Geographical Distribution of the Sub-Order—Ancestry of the Marsupials—Fossil Remains.

VI.—THE OPOSSUM FAMILY.—DIDELPHIDÆ.

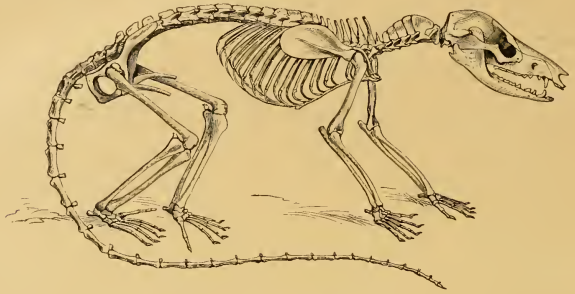
THE Marsupial animals included in this family are not found in Australia or in Van Diemen's Land, or in any part of the natural history province to which those countries belong. They are numerous, however, and are now living on the American continent; but formerly some inhabited Europe during that geological period which is called the Eocene. The Opossums are very rat-like in form, the largest species being about the size of a large Cat, but they have the snout more elongated; and in some species in which the individuals are large the body is proportionately stout, and on most there is a comfortable fur, with short and long hair. The tail is almost always very long, nearly destitute of hair, excepting at the root, and is covered with a scaly skin, there being a few scattered hairs. It is a useful organ, for the Opossums hang by it, and it assists them in climbing and descending trees, and in holding on, when they are young, to their parent. The ears are rather large and round, the eyes are placed rather high up in the face, and the long muzzle ends in a naked snout. The legs look short for the body. The feet are naked beneath; there are five toes, and the great toe is more or less opposable to the foot, and acts like a grasping thumb. Each toe is furnished with moderate-sized claws, excepting the inner toe of the hind foot, which is clawless. The Opossums are remarkable for the great number of their incisor teeth, there being ten in the upper and eight in the lower jaw, and they are arranged in a semicircular manner. The upper and two foremost incisors are rather longer than the rest, and are generally separated from them by a narrow space. They are nearly cylindrical and expanded at the tip. The canines are well developed, the upper ones being the largest. There are three premolars on each side of both jaws, and they have two roots, and are compressed and pointed. There is a posterior talon to them. The molars, eight in each jaw, have three roots, and those of the upper jaw have the crown of a triangular form and tubercular, whilst those of the lower jaw are longer than broad, and each has the appearance of five prickly cusps on its upper surface.



Some of the Didelphidæ have no marsupium, or pouch, or it is very slightly developed, and in these particular kinds the young, after having left the nipples, are carried on the back of the mother, retaining their position by twining their tails around hers. The mammæ are numerous: there may be as many as thirteen, an odd one being found in the centre of the ring of the other nipples.

The Opossums are active, sly, and very intelligent in certain things, and their food consists of insects, small reptiles, birds, and eggs. Living for the most part in trees, they secrete themselves in

the hollows of the branches and trunks during the daytime and sally forth in the night. They have a moderate-sized cæcum. It must be noticed that the great toe of the hind foot is well developed, has no nail, and enables the creature to grasp, and is thus very useful; and that they walk plantigrade. The ankle and leg have the same movements as in the Wombats, and the same general anatomy. If the members of the family are compared with those of the families which live in the Australian province, it will be found that they most resemble the Perameles and Dasyures. The Opossums may be divided into three groups: those whose pouch is well developed, those in which it is a mere fold, and those which have webbed feet and live in the water, like Otters.



SKELETON OF THE CRAB-EATING OPOSSUM.

THE COMMON OPOSSUM.*

This is a large kind, and is about the size of a common Cat, and its long, large, pointed head, ending in a naked snout, and having eyes encircled in dusky brown fur amongst the white hair and fur of the head, gives it a very cunning and thoughtful appearance. The ears are black. The tail is long and prehensile, the end being white and the rest black, and the legs and feet are brownish. It is a great climber, and uses its tail almost as much as some of its Monkey companions. Running along the branches, it will often suspend itself by its tail, and give a swing and let go, thus launching its body to a distance, and then it catches at the boughs with its feet and unclawed but prehensile hind toe-thumb. In coming down trees it uses the tail to steady itself, and to prevent too rapid a fall; and in climbing, the ever-ready tail prevents mishaps, should the clawed toes not grasp sufficiently. The natural food of this Opossum is probably vegetarian, but it is a great birds'-nester; it will eat roots and fruits, but the early settlers found it very destructive to their poultry, for it catches the birds and sucks their blood, not eating the flesh: consequently, it has been much hunted, and as the fur and skin are sometimes used, the destruction of the Opossum has been great. It is a curious creature, and seems to have gained experience in its struggle with man, and as many stories are told of its cleverness as there are about Reynard the Fox and the Indian Jackal. It will sham death in a most persevering manner, and is at the same time very tenacious of life.

The skull has strong temporal ridges, which form a sagittal crest, and the arch of the zygoma is well grown. The animal has a longer facial part of the skull and a smaller brain-case than the other Dasyures, and the brain has large olfactory or front lobes. The cerebral hemispheres are small, and there are no convolutions. This is essentially a North American animal, and is found from Mexico to the Southern States inclusive.

The female brings forth from twelve to sixteen young at a time, and her nest, which is formed of dry grass, is usually at the root of a tree or bush. When first born, the young are said not to be

* *Didelphys virginianum.*

more than a grain in weight, and blind, naked, and shapeless. They find the teats in the mother's pouch, unless she places them on to them with her mouth, and they cling on so as not to be separated except by violence. In about five days, so rapid is their growth, they have reached the size of a Mouse, and all their parts are developed. They then leave the pouch, and return to suckle and when danger appears. During this time the female shows great attachment to her young; and Mr. Waterhouse, from whose work these descriptions are taken, states that she will suffer any torture rather than permit the pouch to be opened.

CRAB-EATING OPOSSUM.

AZARA'S OPOSSUM.*

This is a smaller animal than the common or Virginian Opossum, but its tail is long in proportion to its body. It is the South American representative of its larger fellow species, and is found over a very wide extent of country. It was noticed by the celebrated naturalist D'Azara in Paraguay; Mr. Darwin found it at Maldonado, La Plata; and specimens have been obtained from the Brazils, Santa Fé de Bogota, and Bolivia. This is because it is not entirely a forest animal, but is found occasionally in the open country. It may be distinguished from the common Opossum by three distinct black marks on its head, by its large tail, one-third of which is covered with fur like that on the body. The rest of this important member is scaly, with small hairs springing from between, the

* *Didelphys D'Azaræ.*

scales being black in the second third, and white at the tip in colour. The habits of this Opossum are nocturnal, and it lies concealed by day in burrows in the ground or in thickets. At night it climbs trees to feed upon fruits and birds' eggs. It will chase and catch sleeping birds, and suck their blood like a Weasel.

THE CRAB-EATING OPOSSUM.*

A small Opossum, with a long black tail tipped with white, and a dull-coloured fur to its body, lives in Brazil and Guiana, and has a very omnivorous disposition. Preferring swampy situations, it lives mostly on the trees, hunts small birds and insects, and even catches a reptile now and then, but its fondness for the Crustacea of the swamps is proverbial, and hence its name of Crab-eater.

Another species is interesting from being found in the part of California which adjoins Mexico. The Short-headed Opossum also belongs to this group, and is from the same locality. Besides these, there are several smaller pouch-bearing Opossums, without the long hair of those just mentioned, and they are from Brazil, Guiana, and Surinam—for instance, the Quica, the Naked-tailed, and the Four Spotted kinds. The Philander Opossum is a bird-hunter, and lives in Surinam.

The next group of Opossums have no pouch, but there may be folds of the skin protecting the mammæ.

THE THICK-TAILED OPOSSUM.†

As its name implies, this pouchless Opossum has a very thick tail. Moreover, it has smaller ears than the other Opossums, and has a short head and short legs. The fur is made up of harsh hairs, which are close to the body, and there is but little under fur. Its colour is yellow-brown, but the eye and muzzle are brownish, and the tail, with the terminal two-thirds, is black, with the exception of a small white spot at the end. It inhabits Brazil and Paraguay, and extends southwards to the River Plate. One of the Opossums was kept by D'Azara, who found it quiet, tame, and stupid; but having been fed on raw meat, and a parrot happening to come too close, it killed the bird in a moment. There are folds of skin in the lower part of the abdomen, but no pouch, and there are six mammæ.

Another of the Opossums is called Merian's Opossum, or *Didelphys dorsigera*, and it inhabits Surinam. It was described by Madame Merian in 1717, who represented it in her great book on

MERIAN'S OPOSSUM.

insects with its young clustered on its back and hanging on to the mother's tail, which was curved over its back, with their little tails.

* *Didelphys cancrivora.* † *Didelphys crassicaudatus.*

It is very curious that the young of these pouchless Opossums should resemble those of the whole order in being comparatively little advanced in their development at the time of their birth. The young are at first strongly attached to the teats of the mother, and when they are sufficiently strong and grown to leave them, occasionally she takes them off from the nipples and places them on her back. Here they cling on with their tails to hers. Hence the name of back-bearing, or Dorsigera, which is given to this kind.

YAPOCK.

It was at first supposed that this method of carrying the young was restricted to this species, but subsequent experience has shown that several kinds do the same thing.

Two or three other species of Opossum are interesting from their small size and habits. Thus the Murina Opossum (*Didelphys murina*), with a very long tail, inhabits Guiana, Brazil, Peru, and Mexico. The body is about five inches in length, and the tail is either slightly longer or about the same. Yet this little thing attacks birds and insects; it burrows in the ground, and climbs trees to get its insect food.

The Elegant Opossum (*Didelphys elegans*), of Chili, is still smaller than the last, and frequents the thickets growing on the rocky hills near Valparaiso. They are numerous, or were so when Mr. Darwin observed them, and are easily caught in traps baited with cheese or meat. The tail appeared to be rarely, if at all, used as a prehensile organ; yet they could run up trees with some degree of facility. It is an interesting fact that some of the smallest Opossums prey upon Lizards and Snakes as large, and even heavier, than themselves.

The last section of the Opossums contains the Water Opossum,

THE YAPOCK.*

This animal has a perfect pouch, and has large hind feet, the toes of which are united by a web. The fore feet are moderate-sized, and the pisiform bone is unusually long. Its habits are aquatic.

* *Chironectes variegatus.*

The Yapock has large naked ears, and a long, almost naked, tail, and is altogether rather larger than the common Rat. Its method of life is very much the same as that of the Otter. It is a good diver, and feeds upon crustaceous and other aquatic animals. It is a native of Guiana and Brazil.

The Marsupial animals assume the general shape and habits of many orders of Mammalia which have no marsupium, and which live in the other great natural history provinces. Thus there are Marsupial animals like Dogs, Rats, Squirrels, Flying Squirrels, Deer, &c. They have, therefore, many methods of life as a group, and, as might be expected, the brain and nervous system present many differences in them. In all, the front lobes of the brain which deal with the sense of smell are very large, and in some, such as in the Carnivorous Marsupials, they are exposed, and not covered by the main mass of the brain. In the Kangaroos, however, these olfactory lobes are hidden more or less. These last also have well-marked convolutions on the brain which are nearly wanting in those first mentioned.

The Marsupial animals just considered have been classified to a certain extent during their descriptions, but it is necessary to recapitulate. They are arranged in groups of genera or species, or into families. They are as follows :—

ORDER MARSUPIALIA.—SUB-ORDER MARSUPIATA.

Family	Macropodidæ	Genus	Macropus . . Kangaroos.*
		,,	Dendrolagus . Tree Kangaroos.
		,,	Hypsiprymnus . Potoroos.
		,,	Hypsiprymnodon The Hypsiprymnodon.
,,	Phascolomyidæ	,,	Phascolomys . The Wombat.
		,,	Phascolarctus . The Koala.
,,	Phalangistidæ	,,	Phalangista . The Cuscus. Dormouse Phalanger. Phalangers.
		,,	Petaurus . . Flying Phalangers.
		,,	Tarsipes . . Tarsipes.
,,	Peramelidæ	,,	Perameles . . Bandicoots.
		,,	Choeropus . . Choeropus.
,,	Dasyuridæ	,,	Myrmecobius . Ant-eaters.
		,,	Phascogale . . Phascogale.
		,,	Dasyurus . . Dasyures.
		,,	Thylacinus . . Dog-headed Thylacinus.
,,	Didelphidæ	,,	Didelphys . . Opossum.
		,,	Chironectes . Yapock.

The Macropodidæ, Phalangistidæ, Peramelidæ, and Dasyuridæ are found living somewhere or other in the Australian distributional province, which includes the mainland, Tasmania to the south, and the Moluccа and Arru Islands to the north, bounded by the Straits of Lombok, and Celebes, New Guinea, New Ireland, Timor, Amboyna, Banda, and Waigeoe. Each family is not represented fully, however, in all the remarkably separated divisions of the province. Thus the genera Macropus and Dendrolagus of the first family, Petaurus and Phalangista of the third, Perameles of the fourth, and Phascogale of the Dasyuridæ have been found in New Guinea; but in other islands, such as Celebes, and in those from Lombok to Timor, the genus Cuscus alone is represented. In the Moluccas, Cuscus and the genus Petaurus are found. In Van Diemen's Land about one-half of the species are peculiar to the island, and the remainder are found also on the eastern districts of the mainland. It has Kangaroos, Potoroos, Wombats, Phalangers, Bandicoots, and three out of the four genera of Dasyuridæ. Western Australia, which is such a remarkable botanical province, and is so separated by desert and sand from the east, has numerous Kangaroos, Potoroos, Phalangers, Bandicoots,

* The sub-genera Halmaturus and Heteropus, Osphranter, Lagorchestes, and Petrogale, are included in Macropus, and many other sub-genera relating to the other families merely complicate the classification. Bettongia, Potorois, are sub-genera or artificial groups of the genus Hypsiprymnus; Cuscus, Trichosurus, Pseudochirus, and Dromicia, are groups of Phalangistidæ; Petaurista, Belideus, and Acrobata are divisions of the genus Petaurus; Macrotis is a sub-genus of Perameles; Antechinus is a division of the genus Phascogale; Sarcophilus is a sub-genus of Dasyurus. These are unnecessary sub-divisions.

Phascogales, Dasyures; and, in common with South Australia, a Chœropus, whilst the genus Tarsipes is peculiar to it. The Wombat is found in Van Diemen's Land and some of the islands in Bass Strait. It is found in the south and east of the mainland of Australia, but not to the west and north. Mr. Waterhouse notices that the Marsupials of the eastern districts are for the most part distinct from those of the opposite side of the continent, there being, when his great work, which has been so constantly referred to in this description, was written, but eight species out of upwards of sixty inhabiting the two provinces. South Australia is the habitat of more common species than elsewhere. The northern part of Australia has more species peculiar to it than the other divisions, and some of its Dasyuridæ especially, and species of Cuscus also, are found in the Arru and other islands to the north. The metropolis of the sub-genus Cuscus is in the Moluccas, where two species are widely distributed, or one is restricted to certain islands.

The other divisions of the genus are represented by the Vulpine Phalanger, an animal with long loose fur, which inhabits New South Wales, Western Australia, and North Australia; by Cook's Phalanger, of New South Wales and Van Diemen's Land. The genus Perameles, the Bandicoots, has species in Van Diemen's Land, Australia, New Guinea, and in the Arru Islands, and the genus Petaurus has a corresponding distribution. The Didelphidæ are found in the United States, California, Mexico, Peru, Guiana, Brazil, Paraguay, Banda Oriental, and Chili; and Brazil is the country where they abound the most in species and individuals, the number diminishing to the north and south.

The Marsupials have a great ancestry, and some of them lived when the continents and oceans of the earth were in very different relative positions to those they now occupy. Indeed, it is most probable that the fossil remains of the most ancient mammal belong to this order. There is a small double-fanged molar tooth of a mammal which was found by Plieninger, in 1847, contained in a jumble of shells and of the remains of reptiles and fishes in strata beneath the Lias formation of Diegerloch, near Stuttgart. It and another which was discovered close by, by the same professor, belonged to animals which were dead when this topmost stratum of the Trias, immediately beneath the Lias, was being formed. They are Triassic in age, therefore, and they somewhat resemble the back teeth of a fossil which was found subsequently in the Purbeck strata of England, and which evidently belonged to a Marsupial more or less resembling the existing Kangaroo-Rats or Potoroos, of the genus Hypsiprymnus. Later on, Professor W. Boyd Dawkins, F.R.S., discovered a small tooth belonging to the same extinct genus as that which included Plieninger's fossil, namely, Microlestes; and its resemblance to one of Hypsiprymnus is even greater. Its position was high up in the Trias of Watchet in Somersetshire. Mr. Charles Moore, of Bath, had previously found many specimens of teeth of the same family in a fissure, down which they had been washed by the Triassic sea.

A lower jaw of a small Mammal was found in the Trias of North America by Emmons; and it has on one side three incisors, one long canine, then a diastema, three premolars, and seven molars with three points. It is therefore one of the Myrmecobius group.

After the age of the Trias, when there was much continuous land surface, Europe was broken up into a coral island tract, during the age of the collection of the Jurassic deposits. The islands were tenanted by many small Marsupials, four species of which have been discovered in the deposits of Stonesfield slate at the bottom of the Great Oolite. They belong to the extinct genera Amphitherium, Phascolotherium, and Stereognathus, and the first somewhat resembled the Myrmecobius of recent times; but all that can be said is that they belonged to Marsupial animals. Piled on the Stonesfield slates are many hundred feet of strata, and high up amongst them, in the Swanage and Purbeck districts, are deposits in which Messrs. Brodie and Beckles have found portions of the skeletons of numerous insectivorous Marsupials, of which the genera Spalacotherium, Plagiaulax, Triconodon, and Galestes are the most important. They were small, as a rule, and there has been much debate regarding their affinities with modern insectivorous forms, and they are still surrounded with doubt.

The appearance of the Mammalia without pouches took place in the Eocene age, and in the Old and New World, and contemporaneously with them lived in France a kind of Opossum, some of whose bones were found in the strata of Montmartre, near Paris; and in later Tertiary strata other relics have been found. These are the only instances of a fossil Didelphid occurring out of the New World; and there, where the Opossums are now characteristic animals, they were present in the last geological age, for in the Brazilian latest deposits remains of several species of Didelphys have been found.

Remains of these fossil Opossums have been found in the North American Pliocene deposits. The more ancient deposits of Australia have not yielded the remains of any of the animals which are now so peculiar to the province, but in the bone caves of the Wellington Valley, some two hundred and ten miles west of Sydney, Sir Thomas Mitchell discovered a mass of bones, forming a breccia with limestone, which contained numerous and most interesting Marsupial remains. In deposits of the same late age, and in bogs and gravels in Queensland, other remains were found. They were described by Sir R. Owen in one of his greatest works, and they belong to the Australian families of Marsupials, and not to the American Didelphidæ. As was usual elsewhere before the appearance of man on the earth, and contemporaneously with him for awhile, many of the kinds which resemble more or less those now living, or would be classified in the same family, and perhaps in the same genus, are gigantic. Owen distinguished among the bones those of large fossil Marsupials which belong to the Macropodidæ, and which may be arranged as subdivisions of the genus Macropus or Kangaroos, and of a powerful creature called Thylacoleo, or Pouched Lion, which must be admitted as a new section of the Macropodidæ, and whose habits were probably carnivorous, although there is much diversity of opinion on the subject, some of the most distinguished anatomists believing the creature to have been of an innocent disposition, although appearances are much against it. It is more closely allied to Plagiaulax, of the English Purbeck beds, than to any other form, and they well fit in between the genera Macropus and Hypsiprymnus.

A huge Marsupial, with a skull three feet in length, with teeth, in front especially, on the Kangaroo plan, and with longer fore limbs and shorter hind ones than the last-named animal, was described by Owen. The pelvis, however, has but two sacral vertebræ, and its ilio-pubic process would ally it with the Macropodidæ. This Diprotodon was an herbivorous animal, and was of the size of a Rhinoceros. This great Marsupial had fore limbs which possessed the power of rotation, and it was not without some characters which are seen amongst the Wombats. It appears to have had a great range, for its remains have been found in the caverns in the Wellington Valley, at Welcome Springs, South Australia, Hergolt's Springs, 500 miles north of Adelaide, near Melbourne, in the valley of the Condamine River, and widely over Queensland. A slightly smaller animal, called the Nototherium, also existed with the larger one.

The species of this genus have no lower incisive tusks, and a very short chin; the angle of the jaw is curved inwards, and there were only four molar teeth on each side in both jaws, and they were with two strong roots or fangs. It was probably one of the Macropodidæ. Others of this family are allied to Dendrolagus, and form the genera Protemnodon and Sthenurus. The Wombat was represented in the age of the great Marsupials; and both large and small species, one being of the size of the Tapir, have been described from bones and teeth which were found in the cave deposits of Australia. Remains of a Marsupial animal, probably of the Vulpine Phalanger, were found in the same caves, as were also some referable to the genus Perameles, or Bandicoots, and to the Potoroos. Several fossil species of the family Dasyuridæ have been found in the Australian caves, and one of them is referable to a section of the genus Dasyurus, which at present is restricted to Van Diemen's Land, it being somewhat like *Dasyurus ursinus;* moreover, probably, there was a species of Thylacinus present also. So far as is known from the researches of Owen amongst this wonderful cave fauna, no members of the family Didelphidæ occur there. They were American then, as they are now.

CHAPTER IV

SUB-ORDER—MONOTREMATA.*

THE PORCUPINE OR LONG-SPINED ECHIDNA AND DUCK-BILLED PLATYPUS.†

Why the Monotremata are formed into a Sub-order—The lowest of the Mammalian Class—THE PORCUPINE OR LONG-SPINED ECHIDNA—An Ant-eater, but not an Edentate—Its Correct Name—Description of the Animal—Habits and Disposition—Manner of Using the Tongue—Where it is Found—Anatomical Features: Skull, Brain, Marsupial Bones—The Young—Species of Van Diemen's Land and New Guinea—THE WATER MOLE, OR DUCK-BILLED PLATYPUS—The most Bird-like Mammal—Various Names—Description—Their Appearance and Movements in Water—Their Burrows—Habits of an Individual kept in Confinement—Used by Natives as Food—How they are Captured—The Young—A Family in Captivity—the Snout—Jaws—Teeth—Tongue—Fore and Hind Feet—Heel—Spur—The Shoulder Girdle—Breastbone—Concluding Remarks on the Sub-orders—Postscript on the Monotremes.

THE PORCUPINE OR LONG-SPINED ECHIDNA.

THIS animal is the first example of some Marsupial beasts which are separated into a sub-order, because, in addition to the marsupial bones, there are some internal points of construction which are more bird- and lizard-like than those of the Kangaroo tribes. It contains animals which are the lowest of the Mammalian class, and are found only in the Australian natural history province. The Porcupine Ant-eater, as its name implies, has somewhat the shape of a Hedgehog or Porcupine, and it is fond of burrowing with its peculiar limbs, as well as of eating Ants with the assistance of its long tongue. But its internal anatomy and the construction of the skeleton differ from those of the true Ant-eaters, which belong to the order Edentata. It was called Ant-eater by its first describer (Shaw) in 1792, but a few years afterwards it was decided to belong to the same group as an animal about to be described—the Duck-billed Platypus, or Water Mole—and Cuvier, whilst believing that they both belonged to a peculiar order, separated this false Ant-eater from the Water Mole as a species and genus. He called this Hedgehog-like creature Echidna, from the presence of a spur on the heel, which is perforated, and which was erroneously supposed to be poisonous, like the fang of a Viper (Ἐχιδνα). The correct name is the Long-spined Echidna, or the Porcupine Echidna (*Echidna hystrix*).

The creature greatly resembles a Hedgehog with a very long snout, at first sight, but a slight examination will show that it differs much from the insect-eating and spiny little Hystrix. The Echidna is about a foot in length, and the upper part of its short body is covered with strong spines, and the rest is hairy, the front of the head, and the long, slender, and tapering snout being naked. The legs are short and strong, and the five toes of the fore leg have large and strong claws. This is in order to permit the creature to bury itself in sand and soft earth quickly, and this operation is assisted by a broad and rounded nail on the inner toe of the hind foot and by large claws on the other toes, and especially by a long nail to the second toe. A very long and flexible tongue enables the creature to catch prey. There are no teeth. The skull, when the skin and flesh have been removed, has a very pear-like appearance. It is a great burrower, and manages to get out of the way of observers as soon as is possible, for working actively with its strong limbs and claws, it pokes its snout into the earth and soon gets out of view. Ants are its favourite food, and they are captured in the same way as by the Great Ant-eaters belonging to the Edentata: for in both there is a long slimy tongue, which can be poked far out of the mouth into Ants' nests. The saliva required to make the tongue sticky comes from large glands under the lower jaw from the ear on to the fore part of the chest. When the Ants have collected on the sticky tongue it is taken into the mouth, and they are swallowed. The absence of teeth is made up by the presence of horny spines on the palate and tongue, which look backwards, and these crush and direct

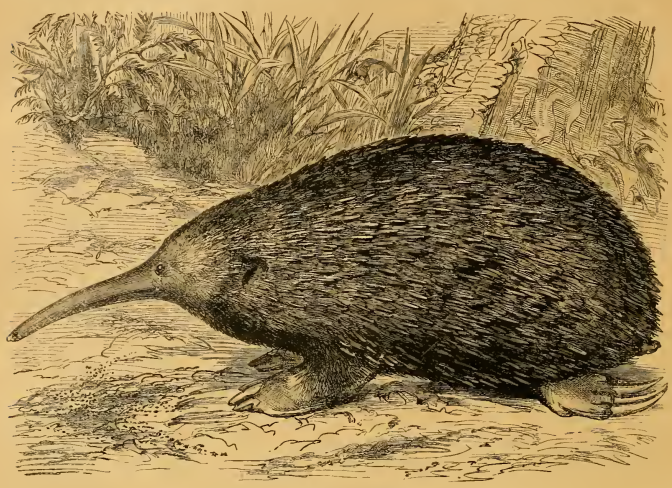
PELVIC ARCH OF THE ECHIDNA.
(*a a*) Marsupial Bones.

* μόνος, one; τρῆμα, opening.

† *Echidna hystrix* (Cuvier). Much confusion has been produced by Illiger, who changed the generic title to Tachyglossus, ταχύς, quick, and γλῶσσα, tongue; but the name given by Cuvier must stand, except in the minds of those zoologists who delight in novelties, and believe that the use of long words carries wisdom. Lately more confusion has been produced by the introduction of the generic term *Acanthoglossus*, which we do not admit or use.

the food to the throat. It is an apathetic and stupid animal, and usually tries to get out of the fight, and it will lie and roll itself up, but not so successfully as a Hedgehog. One of the first which was seen was attacked by the Dogs of two of the travellers, Bass and Flinders, whose names are so familiar from places having been named after them in Australia. The Dogs did not come off victorious, for the new animal burrowed in the loose sand, but not head foremost; it sank itself directly downwards, and left its prickly back just on a level with the surface.

An Echidna was watched, so that the manner in which it could use its tongue was observed. Ants could not be had, but a diet of chopped-up eggs, liver, and meat was readily received, and it was noticed that the tongue was used in the same manner as that of the Chameleon, by simple protrusion



PORCUPINE ECHIDNA. (*After Gervais.*)

and bringing in, and also as a mower moves his scythe, it being curved sideways, and the food swept into the mouth. The Echidna is fond of water and milk, which are licked up by a rapid putting out and drawing in of the long tongue.

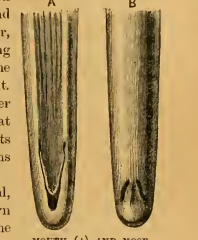
Gerard Krefft says that they are usually found in mountain ranges, and among rocks in the Lower Murray district. He failed to feed them on Ants and their eggs. On hen's eggs they fed for a time, and liked bread-and-milk. He has reason to believe that they live on grass also, as those whose stomachs and intestines he examined had fed on herbs and grasses. The spur on the heel is not used as a weapon of offence.

It inhabits Australia, and has been found as far north as the Bellenden Plains, Queensland, about 18° south latitude. A specimen has also been captured at Cape York, and others at Plain Creek, Queensland. It is not found in Van Diemen's Land.

With regard to the anatomy of the Echidna, it may be said that the long muzzle and the very slender lower jaw give the skull a bird-like look which is increased by the swollen and ball shape of the brain-case. The bones of the skull remain imperfectly united for some time, and

then they are united by plain lines of junction, and not by jagged sutures. The shoulder and the bones of the upper part of the chest resemble those of the Water Mole, and will be noticed in its description. The brain of the Echidna weighs about one-fiftieth of the whole body, and the hemispheres do not conceal the cerebellum. There are three convolutions behind, and in front of them is a large one bent on itself, and on its outside are some oblique folds. The sense of smell, evidently acute in the Echidna, is assisted by a large development of the olfactory lobes of the brain and their nerves.

The Echidnas have large marsupial bones. They have not a true pouch, but only a rudimentary one, or rather an infolding of the skin, during the breeding season, in the female. The orifices of the teats are situated beneath the level of the skin, and inverted; and as the surrounding parts swell under the influence of suckling, there is a little cavity made, at the bottom of which are the so-called nipples. They are really little depressions with hair around them. The young Echidnas are placed in this temporary cavity by the mother, and help themselves by placing their snouts in the small depressions leading to the milk gland. Captain Arnit says that some force is required to get the young out of the pouch, and that there is probably a muscular ring to it. They are at first very small. When about a month or so old, the hinder parts of the young may be seen sticking out of the region of the fold, and at three months the body may be observed, the animal still adhering by its snout. When the prickles of the young begin to harden, the old one turns them out into the world. (But see Postscript, p. 234.)



MOUTH (A) AND NOSE-SNOUT (B) OF ECHIDNA.

A short-spined Echidna (*Echidna setosa*) inhabits Van Diemen's Land, whose hair is sufficiently long to hide most of the spines, but little is known regarding its habits. Quoy and Gaimard, two French naturalists, kept one for a month, and it took no food, but after that time it began to lap and to eat a mixture of flour, sugar, and water. It burrowed very rapidly, and got to the bottom of a large can full of earth and plants in the course of a few minutes, and it was assisted in this by its snout.

A species of Echidna has been found in the north of the Island of New Guinea, at the Mont des Karous and Mount Arfak, at an altitude in the first place of 1,150 yards. It likes the rocky broken ground, and is unknown on the sea coast. The natives call it "Nokdiak," and hunt it for the flesh. As the animal burrows well, the natives dig down about a yard in different places, and generally cut across one of the underground runs. It has been described, and has been named after the explorer, M. Brujn. It is more robust and larger than the species from Australia and Van Diemen's Land, has a very long snout—three times the length of the head—a short tail, and is black in colour with white points. The fur is plentiful, and like velvet, whilst the spines are scanty, and about midway in strength between those of the two Australian kinds. The number of nails on the fore and hind feet is singular in this New Guinea Echidna, for there are three on each instead of five. The tongue of the species is longer and more spiny; moreover, the number of vertebræ differs in this new kind. There are seventeen dorsal instead of fifteen, and there is one caudal more than in the others. The spiny pimples on the tongue and palate, so well developed in this Echidna, have tempted Professor Gervais to include it in a new genus, Acanthoglossus; but it is as well to retain the old name, so that the creature is called Echidna Brujnii. Another species has been found in the south of New Guinea, at Port Moresby, which is distinguished chiefly by the long, thin, cylindrical form of the quills, and the stiff, flat, hair-like bristles on the face. The tint of the flattish bristles covering all the body and limbs, except the back, is brown; on the back are long cylindrical spines, some white and others black. There are five claws to each foot, and the second hind toe is said to be the largest. The fore limbs are short, stout, and strong. It has been named Echidna Lawesii (Ramsay), after its discoverer. All these animals can roll themselves up.

THE WATER MOLE, OR DUCK-BILLED PLATYPUS.*

Like most of the other objects of natural history found in Australia and the neighbouring islands, the Water Mole is very singular in its construction, nature, and habits. It is of all animals that

* *Ornithorhynchus anatinus.*

suckle their young the most like a bird, and it really deserves the title, from its external appearance of half beast, half bird. As its shape and method of life are peculiar, it has received several names, such as the Water Mole, the Flat-footed, Duck-billed Platypus, the Bird-beaked quadruped, and the Paradoxical Bird-beaked animal. It is very fond of the water and also of burrowing in the ground, and, of course, is admirably adapted for these pursuits: hence its construction relates to them to a certain extent, and also to that of the animals of which it was, as it were, a continuation in the scheme of nature.

The Ornithorhynchus anatinus has a rather flat body of about eighteen inches in length, and the head and snout greatly resemble those of a Duck, whilst the tail is short, broad, and flat, and resembles that of a small Beaver, but is shorter. The feet are webbed and flat, and the greater part of the creature is covered with a short dense fur of a dusky brown colour, darker on the upper and paler on the under parts of the body. A slight examination of the habits of the animal will explain the necessity for observing it a little more closely. Mr. Bennett describes his first interview with one shortly after his arrival in Australia. He writes: "We soon came to a tranquil part of the river, such as the colonists call a 'pond,' on the surface of which numerous aquatic plants grew. It is in places of this description that the Water Moles are most commonly seen, seeking their food among the aquatic plants, whilst the steep and shaded banks afford them excellent situations for excavating their burrows. We remained stationary on the banks, waiting their appearance with some degree of impatience, and it was not long before my companion quietly directed my attention to one of these animals, paddling on the surface of the water, not far distant from the bank on which we were then standing. In such circumstances they may be readily recognised by their dark bodies, just seen level with the surface, above which the head is slightly raised, and by the circles made in the water round them by their paddling action. On seeing them, the spectator must remain perfectly stationary, as the slightest noise or movement of his body would cause their instant disappearance, so acute are they in sight or hearing, or perhaps both; and they seldom appear when they have been frightened." On ordinary occasions they do not remain more than a minute or two at a time on the surface of the water.

A burrow of an Ornithorhynchus, which Mr. Bennett opened, had its entrance on a steep part of a bank, situated about one foot from the water's edge, and concealed among the long grass and other plants. "This burrow ran up the bank in a serpentine course, approaching nearer to the surface of the earth towards its termination, at which part the nest is situated. No nest had yet been made in the termination of the burrow, for that appears to be formed about the time of bringing forth the young, and consists merely of dried grass, weeds, &c., strewed over the floor of this part of the habitation." The expanded termination measured one foot in length and six inches in breadth, and the whole length of the burrow was twenty feet. Besides the entrance before alluded to, it appears there is usually a second opening into the burrows below the surface of the water, communicating with the interior, just within the upper aperture. A burrow subsequently examined by Mr. Bennett terminated at a distance of thirty-five feet from the entrance; and that gentleman stated that they have been found fifty feet in length.

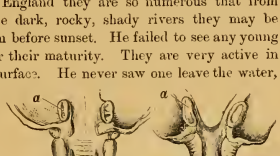
From the burrow first opened by Mr. Bennett a living female was taken, and placed in a cask, with grass, mud, water, &c., and in this situation it soon became tranquil, and apparently reconciled to its confinement. On his return home to Sydney, Mr. Bennett determined to indulge it with a bathe; and with this view, when he arrived in the vicinity of some ponds, he tied a long cord to its leg. "When placed on the bank, it soon found its way into the water, and travelled up the stream, apparently delighting in those places which most abounded in aquatic weeds. When diving in deep and clear water, its motions were distinctly seen: it sank speedily to the bottom, swam there for a short distance, and then rose again to the surface. It appeared, however, to prefer keeping close to the bank, occasionally thrusting its beak into the mud, from whence it evidently procured food, as, on raising the head, after withdrawing the beak, the mandibles were seen in lateral motion, as is usual when the animal masticates. The motions of the mandibles were similar to those of a Duck under the same circumstances. After feeding, it would lie sometimes on the grassy bank, and at others partly in and partly out of the water, combing and cleaning its coat with the claws of the hind feet. This process occupied a considerable time, and greatly improved its sleek and glossy appearance."

The Water Moles are said to have a peculiarly fishy smell, more especially when wet, which probably proceeds from an oily secretion. They are used by the aborigines for food; "but it is no particular recommendation of them," Mr. Bennett remarks, "to say they are eaten by the native Australian, as nothing in the shape of provender comes amiss to him, whether it be Snakes, Rats, Frogs, Grubs, or the more delicate Opossum, Bandicoot, and Flying Squirrel."

The Ornithorhynchus is captured by the natives when in its burrow. They first examine the neighbourhood of the burrow, to ascertain, by the presence of recent footmarks on the soil, whether it is inhabited, and if the examination proves satisfactory, they proceed to dig holes with pieces of sticks from the surface of the ground into the burrow, at distances from each other, until they discover its termination, when the Australians consider themselves exceedingly fortunate should they find the young, since they are regarded as a great delicacy.

The young have been found in their nests by Mr. Bennett about one inch and seven-eighths in length, in the early part of December, and near the end of the same month he found young Water Moles of ten inches in length. These latter were kept alive for nearly five weeks, and their habits whilst in captivity are described in detail in his paper, which is illustrated by some admirable figures, showing their various attitudes, &c. The young were allowed to run about the room; but an old Ornithorhynchus in the possession of our author was so restless, and damaged the walls of the room so much by her attempts at burrowing, that it was found necessary to confine her to the box. "During the day she would remain quiet, huddled up with her young ones; but at night she became very restless, and eager to escape. The little ones were as frolicsome as puppies, and apparently as fond of play; and many of their actions were not a little ludicrous. During the day they seemed to prefer a dark corner for repose, and generally resorted to the spot to which they had been accustomed, although they would change it on a sudden, apparently from mere caprice. They did not appear to like deep water, but enjoyed exceedingly a bathe in shallow water, with a turf of grass placed in one corner of the pan; they seldom remained longer than ten or fifteen minutes in the water at one time. Though apparently nocturnal, or at least preferring the cool and dusky evening to the glare and heat of noon, their movements in this respect were so irregular as to furnish no grounds for a definite conclusion. They slept much; and it frequently happened that one slept whilst the other was running about; and this occurred at almost all periods of the day. They climbed with great readiness to the summit of a book-case, and thus, by means of their strong cutaneous muscles and of their claws, mounting with much expedition to the top. Their food consisted of bread soaked in water, chopped eggs, and meat minced very small, and they did not seem to prefer milk to water."

Mr. Foulerton states that the natives are seldom successful in catching the Water Moles alive, although in some places in the rivers and creeks of New England they are so numerous that from fifteen to eighteen have been shot in an afternoon. In the dark, rocky, shady rivers they may be seen at any time of the day, but in more open places seldom before sunset. He failed to see any young ones, and believes that they keep them concealed until near their maturity. They are very active in the water, and are more frequently under than above the surface. He never saw one leave the water, and states that they made very poor progress on land. As a rule they are to be found in good fellowship with the Australian Water Rat (*Hydromys chrysogaster*).



JAWS OF THE DUCK-BILLED PLATYPUS. (*After Watchouse.*)

(A) Upper, (B) Lower Jaw; (a) Molar Teeth; (b) Narrow Anterior Teeth; (c) Tongue; (d) Integument projecting from Jaw; (e) Transverse Ridges on Covering of Beak.

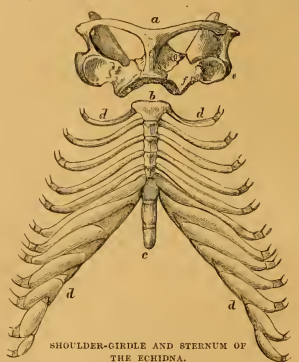
The young Water Moles are naked, and have a short beak with fleshy and smooth edges, and this conformation enables them to seize the space on the mother whence the milk comes, for there are no nipples. Their tongue is large and assists in the sucking also.

The most curious feature in the Ornithorhynchus is the snout in the form of a beak. This is flat and broadest in front where it is rounded. It is hard, and is covered with a skin full of pores, and on each side this skin overlaps the sides to form a kind of fringe or flexible cheek, and this free membrane is carried round the front. Where this skin comes to the head, it forms a wide fold, which flaps over the front of the head and throat, and is a capital protection

when the creature is grubbing in the wet banks or burrowing, and evidently protects the face and the eyes from injury. The nostrils are close to the extremity of the snout. In the lower jaw, or part of the beak-like snout, there are some ridges, which mark it cross-wise from the mouth to the outside, and corresponding structures may be noticed in a Duck, their use being to provide grooves or spaces through which water may pour out of the mouth when the creature is feeding on soft mud and wet substances. Inside the mouth there is a pouch in the cheek, one on each side, and this is to retain food. It has four teeth in the upper and four in the lower jaw, but they are horny and made up of tubes; the front ones are long and narrow, and the others are oblong and oval in form, with a hollow crown. Moreover, the tongue, as in some reptiles, has horny teeth on it. The eyes of the creature are small and brown, and are situated close to the beak, and they look upwards. The ear is hidden by the fur, but it is none the less sharp of hearing. As may be gleaned from the notice of its habits, the animal has great power of swimming but not much of running, although the limbs are short. The fore-feet have five toes, nearly equal in length, the first being rather the shortest, and all have solid and rounded claws. The toes are webbed, and the fold of skin even extends in front of the claws when swimming is going on, but is folded back in digging. In the hind-feet the web does not extend farther than the base of the claws, and there is a spur on the heel, which is movable and sharp. It is found on the adult males in perfection, and it may be useful as well as ornamental. On carefully examining the under and lower part of the body, the milk or mammary glands are to be seen, and there is no proper nipple; but when suckling, the swelling of the gland produces an eminence, which can be grasped by the wide, open, and soft beak of the young.

FORE (A) AND HIND (B) FOOT OF THE DUCK-BILLED PLATYPUS.
(*After Waterhouse.*)
(*a*) Spur on Heel of Hind Foot.

It was thought that this bird-like creature laid eggs, but the point was not easy to determine. (See Postscript, page 234.) It has a double uterus, leading to the common canal, called urogenital, and this ends in the common outlet. The Ornithorhynchus and Echidna have an arrangement of the bones of the shoulder and chest, which resembles to a certain extent that of the Lizards and of the Ichthyosaurus, and the annexed engraving will explain the position of the bones. Indeed, the most important peculiarity in the skeleton of the Monotremes is that of the shoulder-girdle and upper part of the chest; for a bone, the merest vestiges of which are noticed in some of the Mammalia, occurs, that is of some importance in the great groups of birds and reptiles, which are lower in the animal scale than the Vertebrata already described. In all the animals described hitherto, and including the Marsupiata, the large arm bone (humerus) is jointed at the shoulder with the blade bone, or scapula. The socket in this bone, which receives the somewhat ball-shaped top of the humerus, in order to permit of very general motion, is a part of the scapula, and is called the glenoid cavity; but in the Monotremes a bone called the coracoid joins with the scapula, and forms part of the socket;



SHOULDER-GIRDLE AND STERNUM OF THE ECHIDNA.
(*a*) T-shaped interclavicle; (*b*) Manubrium; (*c*) Ensiform end of sternum; (*d*) Cartilages of ribs; (*e*) Scapula; (*f*) Coracoid; (*g*) Epicoracoid.

moreover, this coracoid is long enough to reach the breast bone, or sternum. The breast bone in the Mammalia hitherto noticed consists of an expanded part at its fore end (in the usual position of quadrupeds), or at its top in man, called the manubrium, and of some smaller pieces, which form the front bone of the chest and reach to the belly, having ribs attached to them on each side. This is the state of things in the Monotremes; and the coracoids are attached to the manubrium, one on each

DUCK-BILLED PLATYPUS.

side. In other Mammalia it is the collar bone which is jointed there. In addition to these breast bones in the Monotremes, there are other bones in front, or between the neck and the top of the manubrium. Firstly, there is a bone in the shape of a T: the lower point is on the breast bone, and the cross-bar supports a collar bone on each side, which reaches outwards to the blade bone. Secondly, there is a bone on each side in front of the coracoid, reaching forwards towards the neck. This is called the epicoracoid. Some of these bones, now noticed for the first time, are more or less common to birds, reptiles, and amphibians.

There are some other anatomical points which ally the Monotremes to the reptiles. For instance, the peg on the second, or axis vertebra of the neck, is not fixed to the bone by true bony matter, and some of the ribs which exist in the neck in the Monotremes are separate from the vertebræ until late

in life, or altogether. And the cavity for jointing of the thigh bone with the pelvis (the acetabulum) is not perfect, there being a part of it not filled with bony matter.

The ear is singularly simple in its construction in this sub-order, and the cochlea is not coiled into a spiral; moreover, there is no external ear.

The hemispheres of the brain, which are convoluted in the Echidnas, are smooth in the Ornithorhynchus, and in both the central commissure, or corpus callosum, just exists, whilst the anterior one is large. The Ornithorhynchus inhabits Van Diemen's Land and Australia, as far north as Queensland inclusive.

The Echidna and the Ornithorhynchus belong to a sub-order of the Marsupialia which, whilst it has some structures resembling those of the sub-order of Marsupiata, possesses others which link it with the birds and reptiles. This sub-order is the lowest amongst the Mammalia, and the animals which are included in it have the following peculiarities:—The marsupial bones are present, the uterus is double, and the young are not nourished when within the parent by a placenta; there is no inflection of the lower jaw; the shoulder-girdle has additional bones; there are no true nipples; the teeth are either absent or horny; the external ear is not present, and there is not a true pouch. The excretion of the kidneys and the contents of the bowels fall into one receptacle, through which the young also pass. It is called a cloaca, and receives the outlets of the rectum and urogenital canal. The presence of the spur on the heel is also a peculiarity.

A fossil Echidna has been discovered in deposits on the Darling Downs.

The Echidnas form one genus and the Ornithorhynchus another, and the classification of the whole is as follows:—

Order	Marsupialia.
Sub-Order . . .	Monotremata.
Genus	Echidna.
Genus	Ornithorhynchus.

In concluding this Natural History of the Marsupiata and Monotremata, it is necessary to direct attention to the fact that they are less well defined than the other great groups of the Mammalia. As sub-orders, they are very artificial, for some of their most important structural peculiarities are deficient in some of the genera. The inflected lower jaw is not invariably found, the marsupium does not always exist, and the marsupial bones differ in shape and size, and are occasionally absent. With regard to these bones or cartilages, they are not connected with the pouch, but with the muscular system of the belly. They have been shown by Huxley to be present in Crocodiles, and in the amphibian called the Salamander. Hence these structures are relics of a remote ancestry, and have but slight functional importance. The authorities whence I have derived most of this Natural History are Waterhouse, Owen, Huxley, Bennett, Gould, and Kreeft, to whom I am under great obligations.

P. Martin Duncan.

Postscript.—Mr. W. H. Caldwell has discovered that the Monotremes lay eggs as has been suspected, and he has traced the development of the animal during the hatching. The eggs resemble those of a Reptile more than a Mammal, and the yolk is in such excess that it is not all subdivided during the early stages of the embryo of the Monotreme, but some remains over and above, upon which it is nourished in the early stages within the egg. The heart of Ornithorhynchus paradoxus is interesting because Meckel, and, subsequently, Prof. E. Ray Lankester, F.R.S., have shown that it differs from that of the higher Mammalia, and is not without considerable resemblance in some of the valvular structures to the hearts of Birds and Crocodiles. The last-named naturalist states that the reflux of blood into the right auricle on contraction of the ventricle, is not prevented by the presence of the special structure seen in Mammals, but by an arrangement which is observed in Reptiles and Birds. The mitral valve is with three divisions instead of two, as in the higher Mammalia, but the tendinous structures seen in this last group, to terminate the muscular structures, do not exist in the Monotreme. This increase of the muscular structure is not so palpable in Echidna. It is interesting to know that the special structures of the right side of the heart in the adult Ornithorhynchus are seen in the embryonic condition of the higher Mammalia.

IMPERIAL EAGLE.

THE CLASS AVES.—THE BIRDS.

CHAPTER I.

INTRODUCTION—WING-STRUCTURE AND FEATHERS—DISTRIBUTION.

Introduction—Distinctive Characters of the Class Aves—Power of Flight—The Wing—Its Structure—The Six Zoo-geographical Regions of the Earth—Birds peculiar to these Regions.

THE study of birds is almost an instinct in an Englishman: from peasant to noble, an innate affection for the feathered songsters seems to prevail; so that whether it be in a stately aviary or in a little cage outside a cottage door, birds are found to be the constant companions of man throughout the length and breadth of the land. And it is possible that no other country in the world possesses such a number of birds, in proportion to its size, as does Great Britain. Any one travelling on the continent of Europe cannot fail to notice how few birds meet his eye; and although they may be there, and may be found by a little searching for, they do not form such a prominent feature of a walk as they do in England or Scotland. Even the toiler in large towns has but to get a little way into the nearest fields to hear the cheering song of the Skylark or the Thrush, or to be amused with the bustling and active habits of the Starling, or those of the more sedate and cautious Rook. It is certain that a study of the habits of birds will always repay the student, who may see in the feathered favourites which are around him many a little bright example

to be followed, if he read the lesson aright. Birds teach us many things—perseverance, fidelity, parental affection, thrift, cleanliness, and many other domestic virtues, which are to be seen carried out in their life in the greatest perfection. In the following pages the birds will be passed in review, and the habits of some of the most striking and important forms will be detailed. But, although every species and genus cannot be noticed here, it is necessary to assure the student that in every country—even in England, where so much has been done for Ornithology—he will find an ample reward in the study of all birds; and that even the commonest species cannot be neglected, for there is always something new to learn and to record in their life-history. To quote Dr. A. E. Brehm, one of the most accomplished observers of nature, who, carefully trained by his father, a true naturalist also, has studied the feathered tribes in many climes:—

"He who is only half at home with nature on this earth of ours will be able to approximately to appreciate the feelings with which the naturalist wanders and travels from place to place: wherever he may be he finds friendly forms. For years he has silently watched the interior economy and household arrangements of animated nature, and yet he has not seen all; and on this account he is never in want of employment. Every bird is a personal friend: the old ones he knows almost as well as he knows himself, and the new ones must be studied. How much more is there yet to observe! Rich as he may be in experiences, every fresh ramble brings him fresh mental treasure. The relations existing between him and the bird become each day more and more intimate; he knows the lives and habits of each: when each arrives, or takes its departure: where is its abode: how it is made: when it is occupied by a happy troop of nestlings: when deserted. The naturalist knows his friends by their notes, flight, and bearing. In his eye the bird never ceases to exist: alive or dead it is always interesting in his eyes, for in either case the bird is associated with a poesy of feeling in creative nature which he would put into words. Every new bird raises his spirits a step higher; every fresh discovery is a step onward in the knowledge of the ways and means of all things. He is indebted to his friends for many a happy hour; their lives are a pattern worthy of imitation."*

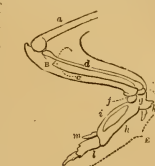
Here, then, we may ask—What is a bird? How can a bird be told from all other Vertebrate animals? The chief character which distinguishes the class of birds is undoubtedly *the clothing of the body with feathers*. Other characters they also possess, but not exclusively. For instance, they have the power of flight developed in the greatest degree: but there are some birds, such as the Apteryx, the Ostrich, and the Cassowary, which cannot fly at all; while, on the other hand, there are flying mammals, such as Bats, Flying Squirrels, and there are flying reptiles, which can progress through the air by means of flight. Again, birds lay the eggs from which they produce their young; but so do many reptiles and fish: so that this cannot be considered a prerogative of the class of birds. Their bill is hard and sheathed in horn; but so is that of the Duck-billed Platypus (page 231), an animal belonging to the Monotreme Mammals; and Turtles also have beaks. Most, but not all, birds build nests; and in this they stand almost alone among the higher animals; but nest-building propensities are developed in many of the Mammalia—in the Lemurs and Mice, for instance—while it cannot be assigned as a habit peculiar to birds, as the wonderful nests made by some fish conclusively prove.

All birds, whether they fly or not, are clothed with feathers, and this distinguishes the class *Aves* in the existing state of nature. The majority are specially adapted for flight: and as this is undoubtedly the most vigorous form of locomotion, the greatest muscular efforts being required to raise and sustain a body above the ground and to propel it rapidly through the air, a large development of muscular energy is necessary. The great strain on the circulation of the blood is met by a heart not only as complete as in the Mammalia, but with stronger and a peculiar valvular mechanism for propelling that fluid vigorously through the body. Moreover, in addition to their lungs, birds possess a singular provision of air-receptacles within the body, and these are connected with a series of cavities, also filled with air, which occupy the interior of most of the bones. These cavities serve not only to give lightness to the bird's body, but they also assist the lungs in aërating the blood, so that birds may be said to enjoy a double respiration. As birds exceed mammals in the activity of their breathing and circulatory system, so also they possess a higher degree of animal heat, their temperature ranging from 106° to 112° Fahr. This high temperature, which exceeds

* Dr. Brehm: "Bird-life," pp. 503, 504.

that of the Mammalia by from 8° to 14°, is maintained by its admirable feather-clothing, which, being a non-conductor, effectually serves to guard against any sudden variations of temperature in the air to which its body is exposed, during its rapid and extensive flights, as well as tempering the usual radiation from the body.

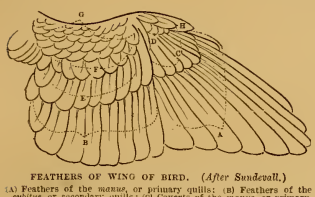
As one might expect in the fore-limb of a creature specially organised for suspension in, and progression through, the air, it is found that the muscles, as well as the bones and joints, of the bird's wing become much modified as compared with the corresponding parts of other animals. With all our scientific knowledge and mechanical contrivances, no one has yet succeeded in constructing a flying machine. It is a significant fact that Nature has not only long ago solved this problem, but that she has done so in several ways. The flight of an insect, of a bird, of a bat, is equally perfect in its way: but in each case the result is attained by very different modifications in the skeletal and muscular apparatus. The principal resistance that a flying animal has to work against is its weight: that is, the force of gravity which, proportionately to its mass, tends to draw it down vertically towards the earth; hence the muscles which are largest and strongest in a bird are those which pull down the wing against the air, thereby raising the body and overcoming its weight.



BONES OF WING OF BIRD. (*After Sundevall.*)
(*a*) Humerus; (*b*) Cubitus; (*c*) Ulna; (*d*) Radius; (*e*) Manus, or hand; (*f*) Carpus; (*g*, *h*, *i*) Metacarpus; (*k*) Pollex, or thumb; (*l*) Second digit; (*m*) Third digit.

The chief muscle thus employed is the "great pectoral," attached to the large keel (or ridge) on the breast-bone, and inserted into the "humerus," or "arm-bone." This "great pectoral" is generally the largest muscle in the bird's body, and in fact often equals in bulk all the other muscles put together.

The wing is *opened out* by straightening the elbow and the wrist-joints. The former process is effected by the contraction of the *triceps;* the latter chiefly by the action of the so-called "radial extensors," and by the elasticity of the long "tensor," or ligament, which comes from the shoulder muscles along the front border of the anterior wing-membrane, and is attached to the base of the thumb, at the front side of the wrist.



FEATHERS OF WING OF BIRD. (*After Sundevall.*)
(A) Feathers of the *manus*, or primary quills; (B) Feathers of the *antibrachium*, or secondary quills; (C) Coverts of the *manus*, or primary-coverts; (D) Lesser primary-coverts; (E) Coverts of the *cubitus*, or secondary-coverts; (F) Median coverts; (G) Lesser coverts; (H) Feathers of the thumb, or bastard wing.

The wing is *folded* by the bending of the elbow and the adduction of the wrist-joints. The elbow is bent principally by the contraction of the "biceps" and the "internal brachial," the wrist-joint chiefly by the contraction of the "hand-adductor," and of the "ulnar wrist-flexor."

As already stated, the possession of feathers is one of the most characteristic features in a bird. These beautiful structures are modifications of the skin, just as are the scales of the feet and the claws of the toes. Feathers and hairs, scales and claws, are all produced out of, and are modifications of, the cells of the upper skin, or *epidermis*, and of the under, or true skin, or *cutis*. The feathers differ much in their minute construction in some birds; and all those of a bird are of course not of the same size and shape, but they have the following parts in common.

A feather consists of a quill, a shaft, barbs, and barbules: moreover, there may be a kind of accessory part, often in the shape of a downy tuft, close to the junction of the shaft and the quill. The shaft (*scapus*) or axis of every perfect feather (*penna*) is divided into the quill (*calamus*), the hollow cylinder (*d*), which is partly embedded in a sac of the skin, and the true shaft (*rachis*, *a*), which bears on each side the lateral processes called barbs (*rami* or *radii*). The rachis and the barbs together are known as the vane (*vexillum*), and, in fact, form what is commonly known as the "feather" in contradistinction to the "quill." The barbs (*c*, *c*, *c*, *c*) are narrow plates, or laminæ, "tapering to points at their free ends, and attached by their bases on each side of the rachis. The edges of these barbs are directed upwards and downwards, when the *vexillum* of the feather is horizontal

The interstices between the barbs are filled up by the *barbules*, pointed processes, which stand in the same relation to the barbs as the barbs do to the rachis. The barbules themselves may be laterally serrated and terminated by little hooks, which interlock with the hooks of the opposed barbules. In very many birds each quill bears two *vexilla;* the second, called the *aftershaft* (*b*) (*hyporachis*), being attached on the under side of the first,"* close to the junction of the shaft with the quills.

In all the feathers of the Ratitæ, and in the case of all but the contour feathers in other birds, there are no barbules to the barbs. The pennæ are ordinarily arranged in definite patches, or areas on the bird, and the shape and size of these, and their relation to one another, differ in many birds.

The *aftershaft* (*b*) is ordinarily a smaller *vexillum*, which is attached to the under side of the larger one at about the point where the rounded quill passes into the stem.

It is not necessary to notice these important characteristic structures more fully now, as they will have to be considered in explaining the distinctions between the great groups of birds, and we pass on to notice that the same kinds of birds are not found everywhere, but that they have, as groups, a remarkable geographical distribution.

In the following pages the distribution of birds is often alluded to, although it will naturally be impossible to discuss, within these limits, all the various phases of the study which the geographical distribution of the feathered tribes opens up to us. At the same time sufficient evidence will be given to show that birds are not scattered without order over the earth, but are more or less restricted to certain spots.

PARTS OF A FEATHER. (*After Nitzsch.*)

The six natural history or distributional provinces into which the world is ordinarily divided by modern naturalists were determined, first of all, from the study of the birds; and in fixing the boundaries of each division the wading birds and many swimming birds must be left out of the question, as they are creatures of such very extensive flight, and wander almost from pole to pole. A natural region, therefore, can be marked only by its resident forms of bird life, or at the most by the birds which breed within its limits; and the six regions alluded to provide us with many excellent reasons for believing that they possess well-defined physical boundaries. No Capercailzie, for instance, was ever found out of the *Palæarctic*† region, which comprises Europe and the greater part of Asia above the line of the Himalayas and the Yangtze-kiang River in China. This region is also characterised by a large number of Buntings, Warblers, Grouse, &c. In the *Nearctic*‡ region there is a certain similarity to the European and Siberian Avifauna, Grouse, Ptarmigan, Waxwings, Magpies, Ravens, &c., being commonly found throughout the two regions. North America possesses, however, several forms peculiar to itself, though it is by no means so rich in species as is the *Neotropical*§ region, which commences south of a line drawn through Northern Mexico, and includes the whole of Central and Southern America. Within this large area are contained whole families of birds, such as Toucans, Mot-mots, the vast majority of the Humming-birds, Trogons, besides innumerable genera of Tanagers and other forms, so that this region is by far the richest in the world as regards bird life. The *Ethiopian* region embraces all Africa below the Sahara Desert and Madagascar: Plaintain-eaters, &c., are characteristic of this region. The *Indian* region skirts the Palæarctic, and includes the remainder of Asia below the Himalayas and the Yangtze-kiang; the Malayan Peninsula, the Sunda Islands, and the Philippines, belong to this region, which contains all the

* Huxley, "Anatomy of Vertebrates," p. 274.

† παλαιός, old; ἄρκτος, north: *i.e.*, the northern division of the *Old* World.

‡ νέος, new; ἄρκτος, north: *i.e.*, the northern division of the *New* World.

§ νέος, new; τροπικός, tropical: *i.e.*, the tropical division of the *New* World.

finest Pheasants in the world, the Impeyan Pheasant from the Himalayas, the Tragopans, and the Lobed Pheasant of Borneo being most beautiful creatures. Lastly, between the islands of Bali and Lombok passes a deep sea boundary called "Wallace's line," which divides the *Australian* region from the Indian, and although these islands lie so close together, the great depth of the channel between them seems to mark them out as frontier lines of two ancient continents. Certain it is that the birds and animals on each side of Wallace's line differ remarkably; and the Australian region, which includes all the Moluccas, New Guinea, and Oceania, in addition to the Australian continent and New Zealand, presents us with forms not found elsewhere, such as Birds of Paradise, Cassowaries, Lyre-birds, and a large variety of peculiar types. Many smaller divisions of the globe are now recognised, but the above are the main ones, which may occasionally be referred to in these pages.*

Many birds migrate, and the student of migration alone would find sufficient material there for the work of a lifetime; and it seems almost impossible to account for the instinct or other causes which bring birds regularly year by year to breed in the same haunts, and which drive them away at the same change of season. Why is it, for instance, that species of similar habits and form, and both visiting Europe in equal abundance, should occupy such different winter quarters? Yet the common Red-backed Shrike, or Butcher-bird (*Lanius collyrio*), when he is said to leave Europe, passes by the Nile Valley along the east coast of Africa down to the Cape, where he brings up a second brood of nestlings; while the Wood-Chat Shrike (*Lanius auriculatus*), a bird of about the same size and of precisely similar habits, proceeds down the Nile Valley and invades Abyssinia in the winter, and also occupies Senegambia, where a Red-backed Shrike has never been found yet by a naturalist. Nothing whatever is known by which route the bird gets to the Gambia: whether he follows the same one as his red-backed relation as far as Abyssinia, and then skirts the southern edge of the Sahara, or whether he reaches north-western Africa by a direct flight across the Great Desert. Many other such problems in the economy of our most familiar species are still awaiting further scientific research.

CHAPTER II.

THE ANATOMY OF A BIRD.†

The Three Divisions of the Class Aves—Anatomy of a Bird—The Skeleton—Distinctive Features—Peculiar Bone Character—The Skull—Difference between the Skull of Birds and that of Mammals—The Jawbones—Vertebral Column—Sternum—Fore limbs—Hind limbs—Toes—The Muscular System—How a Bird remains Fixed when Asleep—The Oil-gland—The Nervous System—The Brain—The Eye—The Ear—The Digestive System—The Dental papillæ—The Beak—Tongue—Gullet—Crop—Stomach—Uses of the Gizzard—Intestine—The Liver, Pancreas, and Spleen—The Blood and Circulatory System—Temperature of Blood of a Bird—Blood Corpuscles—The Heart—The Respiratory System—Lungs—Air-sacs—The Organs of Voice—The Egg—Classification of the Class Aves.

Birds may be separated into three great divisions: the *Carinatæ*, or birds with a keeled sternum, the *Ratitæ*, or birds having a raft-like sternum, and the *Saururæ*, or lizard-like birds. The last of these orders links the birds with the reptiles, and does not concern us here, as it contains only one genus, and that a fossil one, the *Archæopteryx lithographica*, respecting which a few words will be found at the end of this article (Vol. IV., pp. 236–8). The other two divisions are of great importance, and are easily recognisable, although the characters which separate them are chiefly anatomical. The principal point of difference lies in the sternum, or breast-bone, and the name *Carinatæ* is given to all those which have a keel (*carina*) or sternal ridge largely developed, as in the common fowl; and this is present in the great majority of birds. The *Ratitæ* have not got this keel, and in this division are found the Struthious birds—Ostriches, Cassowaries, &c. They are all species which cannot fly; and although the number at present existing is small, the fact of their being found

* Dr. Sclater, F.R.S., originated, in 1858, this scheme of the six zoogeographical divisions of the globe.

† In the preparation of this chapter, the author begs to acknowledge the assistance he has received from his friend Professor F. Jeffrey Bell, B.A.

at widely distant parts of the earth—in South America, in Africa, and again in Australia—would seem to indicate that they were once more plentifully distributed, and that they are remains of what was formerly a large and important group. To these Ratite birds belonged also the extinct gigantic Moas of New Zealand, and the *Epyornis* of Madagascar.

Before proceeding further, it will be necessary to give a brief outline of the principal anatomical features of a bird's body. On examining either the general features of the skeleton, or the minute characters of many of the bones of which it is made up, in such a bird as a Hawk, for example, we are arrested by those remarkable arrangements by which this part of the body is adapted to the mode of life of its possessor. Here, however, as in so many instances, we have to distinguish between what is characteristic of the bird as a flying animal, and what is more or less common to it and other vertebrate animals, and does not especially relate to peculiar habits. We may well be struck by the marvellous power which birds have, and which man has not, and it is curious to notice how man's aspirations have ever been associated with it. Without pausing to observe that painters always endow spirits with wings, or that the imaginative genius of the French has emboldened them to form a "Société d'Encouragement pour la Locomotion Aérienne," we may find in the words of Faust definite expression of what man feels with regard to the law by which he is held down to earth :—

"Ich eile fort, ihr ew'ges Licht zu trinken,
Vor mir den Tag und hinter mir die Nacht,
Den Himmel über mir, und unter mir die Wellen.
Ein schöner Traum, indessen sie entweicht.
Ach! zu des Geistes Flügeln wird so leicht
Kein körperlicher Flügel sich gesellen.
Doch ist es jedem eingeboren,
Dass sein Gefühl hinauf und vorwärts dringt,
Wenn über uns, im blauen Raum verloren,
Ihr schmetternd Lied die Lerche singt,
Wenn über schroffen Fichtenhöhen
Der Adler ausgebreitet schwebt,
Und über Flächen, über Seen
Der Kranich nach der Heimat strebt."*

Inspired by feelings such as those so powerfully expressed in Goethe's lines, numerous naturalists have treated of the bird as though the powers of flight were confined to it, and were not shared by Bees and Bats in the present, and by Pterodactyles in the past. With this word of comment, which it is even still necessary to insist upon, attention should be given to the following avian characters :—The anterior limbs do not touch the ground, and the bones which compose them are adapted for carrying the feathers of the wing; the breast-bone is not only elongated, but has its central portion developed (except in the Ratitæ) into a strong keel, the better to permit insertion of the muscles by which the fore-limb is moved; the small bones (vertebræ) in the region of the back are fixed firmly together, and are not, as in man or in the Ostrich, movable on one another; while those which succeed them are often welded into one mass with the greatly-developed upper bones (*ilia*) of the pelvic girdle; and the hinder vertebræ develop an upstanding plate (ploughshare bone) which gives support to the *rectrices*, or so-called steering feathers of the tail. It will have been seen that the ordinary seizing organ of man (the hand) has in birds been modified to serve another purpose; but this is made up for, not only by the character of the beak, but by the long and flexible neck, and in some by the grasping toes.

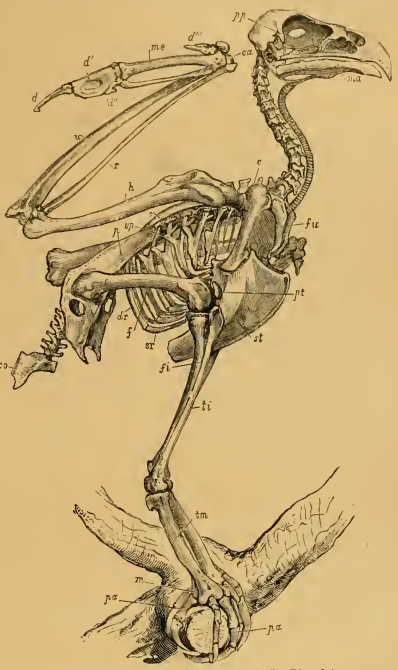
Before describing in detail the characters of the different parts of the skeleton, it is to be noted that many of the bones are not, as in the Mammalia, filled with marrow, but with air; a large cavity may, for example, be seen in the upper bone (*humerus*) of the wing of the common fowl. It is obvious that the specific gravity, or weight of the bird, is thus largely reduced, while the connection between

* These lines are thus translated by Mr. Hayward :—"I hurry on to drink his everlasting light—the day before me and the night behind—the heavens above, and under me the waves. A glorious dream! as it is passing, he is gone. Alas! no bodily wing will so easily keep pace with the wings of the mind! Yet it is the inborn tendency of our being for feeling to strive upwards and onwards; when, over us, lost in the blue expanse the lark sings its thrilling lay; when, over rugged pine-covered heights, the out-spread eagle soars; and, over marsh and sea, the crane struggles onward to her home."

these air-spaces and those which are derived from the lungs enables the contained air to undergo the necessary exchanges with the surrounding medium.

It was long ago observed by the famous German anatomist, Johannes Müller, that "it has often been a subject for complaint that the anatomical characters of birds are so constant that they are of but slight assistance in the labours of the zoologist." The truth of this will very forcibly strike any one who comes to the study of the skulls of birds, after having examined a series of skulls in mammals, so that the seemingly trivial variations to which anatomists have directed attention are in truth those which are, in birds, often of the most importance.

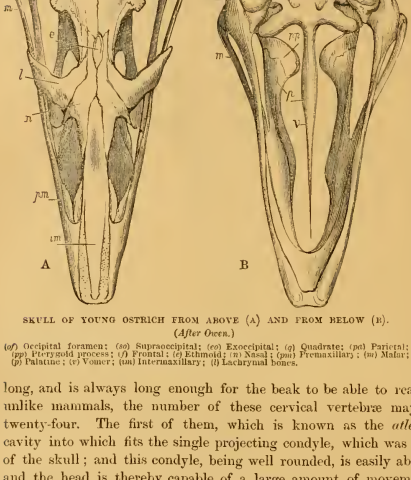
The skull, then, is, as compared with the rest of the body, small; but that portion which contains the brain is relatively larger to the face than it is in any living mammal. The orbits, or cavities in which lie the eyes, are very deep, in consequence of the small extent to which the walls of the brain-case extend forwards. The cavities of each side are separated by a partition (*inter-orbital septum*), which is more or less bony; the nasal bones are short, so that the nasal orifices (anterior *nares*) are placed near to where the beak joins the face. Of the four bones which bound the great opening at the back of the skull for the passage of the spinal cord, three take part in the formation of the single ball-like projection, or condyle, by which the skull is hinged on the vertebral column. In this point, the skull of birds offers a striking point of dissimilarity to that of mammals, in which there are two condyles, one on each side of the great opening (*oj*). Another point in which birds do not resemble mammals is in the mode by which the lower jaw is hinged on the skull. This is in the case of birds effected by a bone, which, being more or less square in shape, has gained the name of the *quadrate* (*q*). In mammals the skull proper and the lower jaw are directly connected. This quadrate bone is connected by a long narrow bar (*quadrato-jugal*) with the bones which go to form the "beak," and also, by a narrow bone directed inwards, with the bones which lie in the middle line of the base of the skull, and form the hard palate. The connections between these bones are often of such a kind as to allow of the upper jaw, or upper half of the beak, being movable on the rest of the skull, the upper bones of which are so completely united together as to form a very firm point of support. In the Parrots this arrangement is carried to an extreme, for the slender bones (nasals and processes of the pre-maxillaries) which connect the upper jaw with the



SKELETON OF EAGLE. (*Reduced. After Milne-Edwards.*)

(*p*) Pelvis; (*c*) Coracoid; (*dr*) Dorsal ribs; (*sr*) Sternal ribs; (*up*) Uncinate processes; (*co*) Coccyx; (*r*) Radius; (*u*) Ulna; (*d*) first phalanx of chief digit of the wing; (*d'*) second phalanx of chief digit of the wing; (*d''*) Phalanges of lower digit; (*d'''*) Pollex; (*cm*) Carpus; (*f*) Femur; (*fu*) Furcula; (*h*) Humerus; (*pp*) Pectoriditni process; (*tm*) Tarso-metatarsus; (*m*) Metatarsus; (*mx*) Lower jaw; (*mx'*) Metacarpus; (*s*) Scapula; (*pa*) Phalanges of foot; (*fi*) Fibula; (*pt*) Patella; (*st*) Sternum; (*ti*) Tibia.

bones of the brain-case form with them a distinct joint, and so allow of that large amount of vertical movement which will have been observed in these birds. The pre-maxillary bones (*pm*), which are so small in mammals, are very largely developed in birds, giving off, as they do, three processes: one to the *frontal bone* (or fore-bone of the brain-case), one along the hard palate, and another externally to form the margin of the beak. The parts that vary most in this bone-group are the bones which make up the hard palate. Of these, the chief are the so-called *palatines* (*p*) and the *maxillaries*; the former are united by an articular surface with the bone which forms the anterior part of the base of the brain-case, while there is in the middle a narrow bone, which, from its shape in man, has received the name of the *vomer* (ploughshare, *v*). The maxillary bones develop horizontal plates, which have the palate below and the nasal chamber above them.*



SKULL OF YOUNG OSTRICH FROM ABOVE (A) AND FROM BELOW (B).
(*After Owen.*)
(*o*) Occipital foramen; (*so*) Supraoccipital; (*eo*) Exoccipital; (*q*) Quadrate; (*pa*) Parietal; (*pp*) Pterygoid process; (*f*) Frontal; (*e*) Ethmoid; (*n*) Nasal; (*pm*) Premaxillary; (*m*) Malar; (*p*) Palatine; (*v*) Vomer; (*im*) Intermaxillary; (*l*) Lachrymal bones.

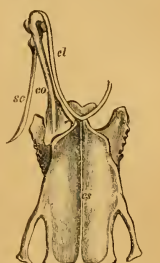
The lower jaw (*ma*) is composed of six pieces of bone on each side—the dentary, angular, surangular, coronoid, splenial, and articular. The upper part of the joint is concave.

The tongue is in relation, as regards its support and movements, to the *hyoid* bones, which will be especially noticed in describing the Woodpecker.

Turning to the vertebral column, we find a number of small bones, complicated in form, and more or less movable on one another. For convenience of description they may be divided into those which belong to the neck (*cervical vertebræ*), to the trunk (*dorsal vertebræ*), to the *sacrum* (so-called because it was offered in sacrifices!), or to the tail (*caudal vertebræ*). As has been observed already, the first of these, or the region of the neck, is very long, and is always long enough for the beak to be able to reach to the base of the tail. In birds, unlike mammals, the number of these cervical vertebræ may be as low as nine, or as high as twenty-four. The first of them, which is known as the *atlas*, has on its front face a rounded cavity into which fits the single projecting condyle, which was spoken of as being found at the back of the skull; and this condyle, being well rounded, is easily able to turn in the cavity which it fits, and the head is thereby capable of a large amount of movement. In the succeeding vertebræ it is possible to make out a body, an upper arch, through which passes the spinal cord, which meets above in the middle line, and is produced into a more or less long spinous process set horizontally to the

* These plates may become united with one another in the middle line, and the birds that possess this arrangement have been called *Desmognathæ* (δεσμός, "a bond;" γνάθος, "jaw"); or they may be separated by a more or less narrow cleft, in which case the birds in which this is found are called *Schizognathæ* (σχίζω, "I cleave"). As a matter of fact, the term Schizognathous is confined to those birds in which the above-mentioned vomer is pointed in front, while where it is truncated the birds are called *Egithognathæ* (αἴγιθος, "a sparrow," as the character is seen in these birds). In these groups, however, the Ostriches, or running birds, which are distinguished by having no keel to their sternum, are not included: nor in them is the vomer narrow behind. This broad character of the hinder end of the vomer is seen also in one group of birds with a keeled sternum—the Tinamous—which are consequently distiuguished from other "Carinate" birds by the term *Dromæognathæ* (*Dromœus*, the Emu).

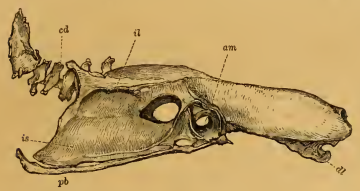
"body," and others directed forwards and backwards, so as to connect each vertebra with its neighbours; and lastly, a lower arch, the two halves of which are not connected below, but are converted into the more or less long ribs. As these vertebræ are so small it is clear that if their spines were long the free movement of the neck would be greatly impeded, and they are therefore in many cases little more than projecting processes. This free movement is further greatly aided by the characters of the two faces of the body (or *centrum*) of each vertebra; the face of each is saddle-shaped, that is to say, the anterior face is concave from side to side, and convex from above downwards, while the reverse of this is seen on the posterior face; in addition to this the vertebræ are separated by a disc of cartilage from one another. The region of the neck is, broadly speaking, distinguished from that which succeeds it by the fact that the ribs connected with its vertebræ do not reach to the sternum, or breast-bone. In all birds which are capable of flight this dorsal region has its parts firmly united together, and the same holds for the parts which follow, till we reach the region of the tail, where the more anterior vertebræ are movable on one another, so as, perhaps, to serve in aid of the steering organ formed by the rectrices, or feathers (*co*). In all living birds the caudal vertebræ are a good deal shorter than the body, but in the fossil *Archæopteryx* they are longer.



STERNUM OF FREGILUPUS VARIUS. (*After Murie.*)
(*cl*) Clavicle; (*sc*) Scapula; (*co*) Coracoid; (*cr*) Keel of Sternum.

The only important point to note with regard to the ribs, is the presence on some of them of backwardly directed hooked processes (*up*, fig. on p. 241), which aid in giving firmness to the thoracic region. The number of ribs is variable, but there is never a large number connected with the dorsal vertebræ, as there are in some Carnivora, in Hyrax, and in the Horse.

The fore and hind limbs are connected to the body by a series of bones, which form the breast and hip girdles respectively; with the former series is also connected that large, long bone with its sharply-projecting ridge (*is*), which is known as the breast-bone, or sternum, and in the depressions on which so much muscle is collected. This sharply-projecting ridge to the sternum, which is known as the carina, or "keel" (*cs*), is found only in the flying birds, though here and there, as in the Parrot of New Zealand (*Strigops*), it is very rudimentary. The lower edge of the bone is often imperfect, so that, as in the fowl, there are two deep clefts on each side, or there may be but a single cleft, and this again may be converted into a rounded space; in all cases these clefts or holes are covered, or filled by membrane, during the life of the animal. Projecting in front of the sternum, and often intimately connected with it, are the two clavicles (*cl*), which unite in the middle line to form the bone of childhood's delight—the furcula, or "merry-thought." Above, this bone is connected with two bones, one of which, called the coracoid (*c*), descends on each side to fit into a depression on the upper edge of the sternum, while the other, known as the scapula, or shoulder-blade (*sc*), is set at an angle to the coracoid. The scapula has a backward and downward direction; while it may be noted that among mammals the coracoid is well developed only in *Echidna* and *Ornithorhynchus*. These two last bones form, at their point of junction, a cavity into which is fitted the head of the long bone of the arm (wing). In the Ratitæ, it must be observed, these two bones are not set at an angle to one another, and they become more firmly united together.



PELVIS OF AN ADULT FOWL, SIDE VIEW. (*Reduced.*)
(*After W. K. Parker.*)
(*il*) Ilium; (*is*) Ischium; (*pb*) Pubes; (*dl*) Dorso-lumbar vertebræ; (*cd*) Caudal vertebræ; (*am*) Acetabulum.

As in all the vertebrate animals except fishes, the fore-limb may be divided into three parts (fig. on p. 237)—upper arm, in which there is one bone, the humerus (*a*); fore arm, in which there are two, radius (*d*) and ulna (*c*); and hand (E), which can again be divided into three parts, which in man would be called wrist, palm, and fingers. Now, in some animals the wrist-bones may be ten in

number, and the palm-bones five, while the number of small bones in the fingers varies a good deal, but the number of fingers is *five*. In most birds all these numbers are reduced. Just beyond the fore arm, the larger bone of which has often small projections indicating the points at which the secondary feathers have been attached, there are two small bones (*f*), then comes a longer bone (*g h i*), as it seems, in which there is an elongated space. Now, this bone consists of three metacarpals and one wrist-bone; the two outer metacarpals are absent, the two innermost ones have completely united with one another, and with the (true) middle metacarpal bone at their upper end; while the second and third metacarpals are also united at the other—or finger—end. The inner digit (*k*), or that which corresponds to man's thumb, has two joints (*phalanges*), and may be clawed; the next has three joints, and may also be clawed; while the third finger, which has never more than two joints, is never known to carry a claw. In the *Archæopteryx* the metacarpal bones are well developed, and are not, as in recent birds, united together. No idea of a bird's flying powers can be fairly gathered from the length of the hand, for it is long in Swifts and short in Albatrosses, for example; although it is to be noted that in the former the single bone (*humerus*) of the arm is short, and in the latter long.

As in the breast-girdle, the bones of the hinder or hip-girdle, by which the hind-limbs are connected with the body, are three in number; of these the upper one is greatly flattened out and projects very far forwards, thus aiding in the formation of the firm back of flying birds; the other two bones are much more slender, and are directed backwards and downwards. It is a curious circumstance that it is in one bird only, in either case, that these bones are directly connected at their lower ends with their fellow on the opposite side; those which are known as the *pubes* (*pb*) are so in the African Ostrich, and those which are known as the *ischia* (*is*) in the Rhea of South America. These two bones, with the large, flat *ilia* (*il*), take part in forming the cavity in which the head of the thigh-bone plays; the outer of the two bones (*fi*) which are found in the leg is rarely as long as, and is always much more slender than the other (*ti*), which has a strong ridge on its front face. There is yet another very remarkable point of resemblance between birds and reptiles, in that the "ankle-joint" is in both cases situated between the two rows of bones which make up the "ankle" (*tarsus*). In birds this arrangement is carried to a still further extent, for the single bone of the upper row is early united with the shin-bone, as may be seen under those unfortunate circumstances in which the poulterer has provided an aged fowl (aged, that is, for eating); in more fortunate cases it will be found possible to separate a small bone from the lower end of the shin-bone of the leg.

In no case does any bird, even *Archæopteryx*, possess a fifth toe. Unlike mammals, the number of joints in the toes varies greatly in birds. In those which possess four toes we find the following number of joints: in the first, two; in the second, three; in the third, four; and in the fourth, five. This rule holds for nearly all birds, but the Swifts have never more than three joints, and in the Goat-sucker and the Sand Grouse there are two less than ordinary on the fourth toe. In a number of birds the inner toe (big toe of man) disappears, and in the Ostrich proper the next division of the "typically" five-toed foot, or second toe, has no toe-joints.

In dealing with the muscular system of birds, we need here concern ourselves with only those special muscles which are modified in accordance with the necessities of the bird's habits, and those other muscles which have been brought into special notice by valuable investigations.

That great fleshy mass which is found on the breast of a bird, and which is not unknown to those who are fond of a good "dish," consists of three separate muscles, two of which depress, while the other elevates the wing. The presence of the elevator muscle on the lower side of the sternum is a curious arrangement by which the centre of gravity of the animal is lowered—a most necessary condition in flight; the tendon from this muscle passes through a pulley-like canal to be inserted into the upper side of the head of the bone, which, as has already been explained, is known as the humerus, so that when it contracts it draws this bone up. The ability of the wings to resist the pressure of the air is clearly dependent on the power possessed by these muscles. Borelli has calculated that the "pectoral muscles" of the bird exceed in weight all the other muscles taken together, whilst in man the pectoral muscles are but a seventieth part of the mass of the muscles.

The large and important muscles, which in the Mammalia constitute the *diaphragm*, or

midriff, are ordinarily said to be absent in birds, and, indeed, in most cases are but feebly represented. In the Ratitæ, and especially in the New Zealand form (*Apteryx*) of this group, the diaphragm may attain to a very fair degree of completeness, though even here the apex of the heart is allowed to pass into the abdominal cavity. The muscles of the back are feebly developed, as might be imagined from the firm character of the spinal column; and as the fore limb exhibits but slight power of *varying* its movements, its muscles are not well developed. Those muscles which are found in the skin are, on the contrary, expanded into broad pieces; and special bundles are sent to the larger feathers of the wings and of the tail, and to those folds of skin which connect the upper arm with the trunk, and with the fore arm, respectively. Borelli thus explains the arrangement by which a perching bird remains fixed when asleep: A muscle which arises from the *pubes* bone of the hip-girdle passes over the knee, and then takes a backward direction so as to pass behind the ankle; it thus becomes one of the flexor muscles, by the contraction of which the toes are flexed, or bent. When the perching bird, which, as we know, has one of its toes directed *backwards*, is seated on a bough, the thigh has its upper end directed backwards, while the upper joint of the leg is turned forwards, or in other words, the two parts of the leg have opposite directions. This arrangement acts as a contracting influence on this muscle and its tendons, while the weight of the bird is sufficient to preserve this condition and the consequent flexion of the toes.

To turn to those muscles the arrangement of which has been made the basis of a suggested classification. In the leg of the bird there are, among others, four muscles, the names of which are *femoro-caudal*, *accessory femoro-caudal*, *semi-tendinosus*, and *accessory semi-tendinosus*, any of which may be absent, but in those cases where a single muscle only is found the first is always present; again, there is a muscle which, from its course, is known as the *ambiens*, and this, too, may be present or may be absent. As the presence or absence of any of these muscles is a very constant phenomenon in any given section of birds, it has been proposed to divide the class into those which do, and those which do not, possess the above-named *ambiens* muscle. In the latter group the second of the four above-named muscles—the accessory femoro-caudal—is never present.*

Of all the muscles, those which act in aid of the vocal organs are of the greatest interest, but they will be considered a little later on.

A valuable suggestion has been made, which, if followed out, may lead us to understand how it is that the brain of the bird, which is so simple as compared with that of man, is nevertheless capable of so much intelligent activity. Bearing in mind the axiom that it is quality not quantity that tells, and looking at the fact that the brain of the most highly intelligent man is, after death, supposed to be similar to that of the foolish and of the unwise of our race, it is obvious that the essential difference must lie elsewhere than in the coarser, or more evident, characters of that organ which is known as the brain. The suggestion, then, that was made, was to the effect, that the possessors of aviaries, in which it was possible to study the characters of birds, should submit the brains of their deceased favourites to that more thorough investigation which the microscope allows of. The brains of birds vary but little in their anatomy. The optic lobes are rounded, paired, and tubercular in the bird, and are not divided into four, as in mammals; they are found at the lower part and sides, and not in the upper part of the brain. The *cerebellum* is not continued at the sides into distinct lobes; nor are the two lobes of the brain (or *cerebral hemispheres*)

* The presence or absence of it, or of the other muscles, is used as a means for arranging the smaller divisions of the larger groups into which the two first-named sub-classes are, by the aid of other anatomical facts, divided. One striking advantage of this system, as suggested by the late Prof. A. H. Garrod, is that the characters of the *ambiens* have been observed to go hand in hand with certain other characters. Thus, the cæca found at the end of the small intestine are always present in the Homalogonatæ, or birds having the normal arrangement of knee-muscles; but in this connection there is another structure to be mentioned, namely, the so-called oil-gland, or gland by the secretion of which the bird "preens" its feathers, and which is always set in the skin in the region of the tail. Now this "uropygial," or oil-gland, may or may not be provided with a tuft of feathers, and as there may or may not be cæca to the intestine, it follows that—(1) the gland may be tufted and there may be cæca, or (2) the gland may have no feathers and cæca may be present, or (3) there may be no cæca and a tufted gland, or (4) there may be no cæca and no tufts (the possible arrangement of neither being present is found in a few Pigeons). But this is not the place to follow out the details of this classification.

With regard to the proposition made by a French observer, M. Alix, that birds should be divided into the Homœomyarii, Entomyarii, and Ectomyarii, according to the character of certain of the flexor muscles at the back of the leg, it seems only necessary to remark that so far anatomical investigations have not supported his views, while his system would separate birds which seem to be closely allied.

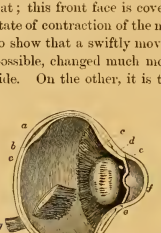
provided with those convolutions which, in mammals, seem to increase in complexity of character as the animal rises in the scale of intelligence. The cerebrum does not cover the cerebellum. Small as is the brain of birds, it is found that, in many, its weight is, as compared with that of the body, much greater than it is in man.

With reference to the spinal cord, or the continuation of the central part of the nervous system through the vertebral column, it is only necessary to remark that it is much increased in width at the two regions, in which the nerves for the fore and hind limbs are respectively given off; that there is a narrow canal running along its centre, and that at the lower end there is a large space. In regard to the cerebral nerves, those for the eyes are of great size.

Coming now to consider the organs of the senses, and beginning with the eye, it is interesting to note that there are no blind birds, and, indeed, the eyes are of a large size as compared with the brain. They are generally placed at the sides, though the nocturnal birds of prey (in which they are directed forwards) are an exception to this rule. It is in very rare cases that eyelashes are present, and although they seem to exist in the group just mentioned, it is probably more correct to look upon them as slightly modified feathers.

If the eye be regarded as having on its front face, a part which would, if completed, form part of a smaller circle than the rest of the eye, it is clear that this *cornea*, or front part, would be more convex than the rest, and that it would consequently be a "more powerful glass," inasmuch as it would exert a greater bending (refracting) influence on the rays of light which pass through it, while, further, it is clear that the more convex it is the better "glass" would it be. Now this is just what happens in birds: the *cornea* is very convex; in addition to this, the long axis of the eye, on the length of which it seems that, in many cases, the condition known as that of being "short-sighted" depends, is very long in some birds, and notably in the Owls.

The eye is covered in by a firm and strong membrane, which is known as the "sclerotic;" this, in its front part, develops a number of bony plates; of these there may be as many as twenty, and they are capable of a certain amount of free movement on one another. What is known as the power of accommodation depends upon the extent to which the front face of the somewhat lens-shaped body which helps to separate the eye into two chambers is capable of being rendered more or less flat; this front face is covered by a membrane which is found to be more or less taut, according to the state of contraction of the muscles (ciliary muscles) connected with it. A very little reflection is sufficient to show that a swiftly moving animal has the focus of its eye, or the point at which clear vision is alone possible, changed much more rapidly than an animal which moves more slowly. So much on the one side. On the other, it is to be observed that muscles vary in structure; they are either "smooth" or "striated," and it is the latter that contract the more rapidly. Putting these two series of observations together, it is easy to arrive at the result that a bird should have striated muscular fibre in its ciliary muscles, and a more slowly moving animal like man, smooth muscular fibres; and this we find to be the case! The *iris* is an arrangement by which the quantity of light admitted into the eye is enabled to be varied, and the small hole in the centre, through which the rays of light pass, is known as the *pupil*; this is always rounded in birds, and is never elongated as it is in some mammals—the Cats, for example.*



SECTION OF THE EYE OF THE COMMON BUZZARD.
(*After Macgillivray.*)

(*aa*) Sclerotic; (*bb*) Choroid Coat and Pigment; (*c*) Ciliary Circle; (*d*) Lens; (*ee*) Iris; (*f*) Cornea; (*g*) Optic Nerve; (*h*) Pecten.

But the most peculiar arrangement in the bird's eye is the presence, projecting into the hinder chamber, of a membrane in which run blood-vessels; this, which is known as the *pecten* (comb), or *marsupium* (pouch), enters the vitreous humour, which fills up this hinder chamber by the same cleft as the optic nerve. It is folded, and is generally of a quadrangular shape; it is not found in the eye of the Wingless Bird of New Zealand (*Apteryx*).

A third eyelid is well developed in this class; it is an elastic membrane (*membrana nictitans*, or winking membrane), which has not, like the other two, a vertical movement, but is drawn obliquely over the eye from the inner to the outer side. This movement is effected by two special muscles, one of which arises on the inside, and below the eyeball, and has therefore to pass over to the

* Compare Vol. I., p. 213.

outer side. In contracting, it would press on the optic nerve, were it not for the other one, which, however, is so disposed that by its contraction it draws away the tendon of the *pyramidalis* muscle from pressing on the nerve. As in ourselves, there are six special muscles for moving the orbit or ball of the eye, but the one which in man is well enough known as the *trochlear*, has no pulley-arrangements in birds. Lachrymal glands are present.

With regard to the organ of hearing, one particular part, which in man is in the form of a snail's shell, and is known as the *cochlea*, is not coiled into this shape in birds, being very slightly bent, though holding in other respects the same general relations. Nor is there any external ear, as in mammals, for collecting the waves of sound; there is, however, in the nocturnal birds of prey a crescent-shaped valve on which are set tufts of short feathers, and it is possible that this may aid in hearing. Nor, again, are there in the interior of the ear those three small bones, which are known generally as the auditory ossicles; of the two that are absent, one is thought by many anatomists to be represented by the quadrate bone, which, as has already been mentioned, connects the lower jaw of the bird with the skull. The single bone which is present, and which is, perhaps, most generally known as the "columella," is connected by two or three cartilaginous processes with the drum of the ear, and by the other end—at which it has a small oval plate—with the more internal parts of the organ of hearing. In man there is a curious arrangement of rods, which vary in so remarkable a way as to have led to the supposition that each was adapted to a distinct note; these rods, which constitute the organ of Corti, are not present in birds, affording thereby a striking example of the law that physiological inferences are often well examined by the aid of comparative anatomy, no physiologist being hardy enough to deny to birds the power of appreciating those delicate modulations of sound which go to make up the chief charm of music. With regard to the organ of smell, it is only necessary to note the absence of those muscles by which, in man and other mammals, the nostrils are contracted or dilated.

The first point which attracts us on examining the digestive tract of birds is the absence of lips and of teeth; but with regard to these latter we must note that it is a character which has only become distinct since the time when birds were first developed. This statement is borne out by two series of facts, each taken from one of the two great aids to a correct apprehension of the real importance of structural characters—that is, from embryology, or the study of the developing individual; and from palæontology, or the natural history of the past. The young of certain Parrots have been observed to possess, at an early stage of their development, those uprisings on the mucous membrane of the jaw which go by the name of "dental papillæ," and these papillæ have been seen to be covered with a cap of dentine. On the other hand, the researches of Owen and of some American palæontologists have brought to light bird-like forms which were provided with teeth (Odontornithes: *Ichthyornis, Hesperornis*).

The *beak*, or horny covering of the jaws, varies very greatly in form, and in the degree of its sensibility. This tactile sense is dependent on the extent to which the beak is supplied by nerves (from the fifth cerebral nerve). In the Woodpecker, for example, there is a large branch extending along the inside of the lower jaw, which, as it approaches the extremity, breaks up into finer nerves that perforate the bone by a number of small canals and so give to the beak a power of discovering what lies hid in the crevices of the wood and under the bark. Being an external structure, the beak is naturally adapted to the habits of its possessors, so that it may be hooked, as in many flesh-eating forms, or trenchant, and fit to cut and break, or provided with transversely-set fine plates by which the water taken in with the food can be filtered off, or provided with bristles, the better to hold a living prey. Finally, in many cases the hardness of the bill is made up for by a patch of naked skin at the base of the upper mandibles, which is known by the name of the "cere" and seems to have a tactile function.

In many birds, the tongue is either feebly developed, or is encased in horn, so that it can hardly be as useful an organ of taste as is our tongue: in the Pelicans it is obsolete. In some, however, as in the Woodpecker, the tongue is a very powerful seizing organ, as it is protruded with great rapidity by means of a special muscle, and is well provided with a sticky secretion, which is given off from a large gland (the sub-lingual), which, lying below the muscle above referred to, is compressed when this muscle contracts; so that in the Woodpecker, just as in the mammal called the Great Ant-eater (*Myrmecophaga*), the insect prey is easily captured.

The region of the mouth is not separated from that which follows it (the pharynx) by an epiglottis, which in ourselves protects the entrance into the air-passages, nor is there any uvula to guard the posterior orifice of the nose by which the air reaches the throat. The succeeding portion of the gullet (the œsophagus) is very long, as might be supposed from the length of the neck in most birds, and it is very frequently either dilated at one side, or produced into a cæcal pouch (crop, *ingluvies*), which may, or may not, be separated by a narrow connection, from the rest of the gullet, and which may be divided into two compartments. This crop serves for the detention of the food, which cannot have undergone any complete process of mastication, and it is here treated to a process of maceration by the fluid secreted from the walls of this organ. Passing from this receptacle, the food becomes subject to the action of the stomach proper, which differs, however, from our ordinary conception of a stomach, as seen in man, by being divided into two distinct portions. The anterior one is known as the *proventriculus*, and it is in this that the gastric juice is brought to bear upon the food, and its walls are consequently thickened by a glandular layer; the hinder division, which is known as the *gizzard*, forms an elongated sac, with two orifices—one from the proventriculus, the other leading to the small intestine—in its upper portion. The characters of its walls are very different in those birds which live on animal, as compared with those that live on vegetable (grains) food; in the former they are membranous and thin, but in the latter they are enormously thick and very muscular. On examination, it is seen that the dark colour of the muscles is on each side of the gizzard relieved by a shining spot of tendinous material, and the walls of the gizzard have consequently been compared to a double-bellied (digastric) muscle. The internal cavity of the gizzard is lined with a dense and rough coat, and is ordinarily found to contain small stones, and occasionally other hard materials. These obviously take the place of the absent teeth, when the muscles of the gizzard set up that (grinding or compressing) action by which the ingested seeds are broken down. The wall of the gizzard may itself also act as a rasping organ, being, as it often is, provided with a firm glandular layer, the secretion of which is converted into a hard lining, the structure of which has been observed in some cases to be due to interlaced filaments secreted from and continuous with the glands in the wall of the gizzard.

DIGESTIVE ORGANS OF THE KING-FISHER.
(*After Macgillivray.*)
(*a*) Tongue; (*b, c, d*) Œsophagus; (*d, e, f*) Stomach; (*f, g, h, i, j, k*) Intestine; (*j, k*) Cloaca.

Notwithstanding the differences in the character of the gizzard in carnivorous and graminivorous birds, it has been shown by the ever-famous John Hunter that carnivorous birds can be brought to live on grains, and grain-eating birds on meat.

It is interesting, further, to note, with regard to the opening into the small intestine, that in a number of grain- or fruit-eating birds there is no valvular arrangement to detain the food in the gizzard till it is completely triturated, for it is thus that many plants have their area of distribution increased, the escaped seeds passing uninjured from the intestine to find, perhaps, a suitable soil in a new district. In those that swallow large stones a valve is often to be observed. The difference which we have already had so frequently to notice, as obtaining between the carnivorous and "vegetarian" birds, is seen to be continued into their small intestine; just as in mammals, this portion of the tract is longer in the latter than in the former birds. The anterior, or *duodenal* portion, is always characterised by forming a loop, within which lies the gland known as the *pancreas*, and the succeeding portion is, as compared with most mammals, short. A slight elevation, hardly ever of any great size, may at times be observed on the course of the short intestine. This represents all that remains of the duct by which the hatching bird was connected with the yolk. The short and straight large intestine is ordinarily separated from the preceding by a cæcum; this is generally paired (in the Herons and some others it is single), and varies in length; in many cases these cæcal tubes are hardly more than papillæ. In the Parrot, as in the Woodpecker and some others, these cæca are absent. In the desert-dwelling Ostrich (*Struthio*) they are said to be as much as two feet long; but in the Emu they do not exceed six inches in length.

The intestine ends in a cavity, which is common to it, and to the other organs that open to the exterior in this region. This *cloaca* (sewer) is found in reptiles also, and in one division of the

Mammalia, the Monotremata. In birds it is provided with a special glandular appendage on its upper (or *dorsal*) aspect, which goes by the name of the *Bursa Fabricii*. Neither the history nor the functions of this peculiar organ can be said to be thoroughly understood.

Of the organs which are appended to the intestine, the lungs will be described elsewhere; of the rest we have to consider the liver, the pancreas, and the spleen. The first-named organ is large, and covers over the pancreas, the proventriculus, the spleen, part of the gizzard, and part of the small intestine. It is ordinarily divided into two "lobes," between which, on the upper edge, is placed the tip of the heart. In the common fowl the left lobe is often divided into two; but this organ is never broken up into so large a number of parts as it is in many mammals, from which animals birds also differ in always having more than one duct to carry off the secretion of the liver (bile) to the small intestine, except in the Ostrich; in this, as in some other birds, there is no gall-bladder in which the bile may be collected, so that in such this secretion passes directly into the intestine.

As has been already pointed out, the commencement of the small intestine forms a loop, in which is set the organ known as *pancreas*, which may for simplicity be described as the salivary gland of this region, although in truth the fluid secreted from it is a much more powerful aid to the digestion of food than that of any known salivary gland. It has always two, and in a number of cases three ducts, which do not unite with the bile ducts, but open separately from, though near them, into the end of the "duodenal loop." The *spleen*, which is a small oval body, and is placed to the right of the proventriculus, has no ducts; in birds of prey it is more cylindrical in shape.

The temperature of the blood of the bird is, in requirement with the conditions of its existence, hot—that is to say, it is ordinarily hotter than the temperature of the surrounding air, and is found to register between 100° (Gull) and 112° (Swallow) on Fahrenheit's scale, or from two to fourteen degrees more than does that of man. Birds and mammals, are, speaking broadly, the only hot-blooded animals now existing, and it has consequently been suggested that they should be grouped together as such, in opposition to the rest of the Vertebrata. But it is obvious that this character of the temperature is merely dependent on physiological conditions; and were this a treatise on the anatomy of birds rather than one on their natural history, the statement of this fact would not receive the prominence here given to it. The high temperature of any body may be preserved from cooling influences by two methods: thus, tea in a well-polished silver teapot keeps hot because the rays of heat are but slightly radiated from its surface; or a less costly teapot may be kept hot by covering it with a loosely-fitting "cosy," which, being made of badly-conducting materials, "keeps the heat in." It is, then, clear that the heat of a body is best preserved when it is covered by a bad radiator and a bad conductor of heat; and this is just the case with birds: the polished feathers are bad radiators, and the air entangled among them forms a bad conductor.

The blood corpuscles are, broadly speaking, about twice as large as in man; those which are coloured red are oval in shape, as they are in nearly all of the lower Vertebrates and in the Camels among mammals. Like the white ones, they are "nucleated." The heart is, as in mammals, divided into four chambers. It is a condition of the circulation in hot-blooded and rapidly-breathing animals that the current of *arterial* blood *from* the heart, and the current of *venous* blood *to* it, should be kept as much as possible separate; no reflection is needed to show that the blood freshly purified by contact with the air in the lungs must be kept as distinct as can be from the blood which has lost its purity in passing through the body; in other words, it is required that there should be a similar result in birds and in mammals.

Birds, like all warm-blooded creatures, have the heart divided into four cavities—two ventricles and two auricles—those of the right side being completely separated from those of the left. The whole is enclosed in a pericardium, a thin, but strong, membrane. The right ventricle has thin muscular walls, and almost completely envelopes the left. The right auricle has a remarkable valve in the shape of a fleshy leaflet, which appears almost to be a portion of the inside of the ventricle that has become detached from the partition between the two ventricles. The blood, under certain circumstances, passes between this septum, or partition, and the leaflet, into the auricle; but when the beat of the heart takes place (the systole), the septum, being convex, is forced against the leaflet on the other side of the auricolo-ventricular opening, and the passage of the blood, through this, is

prevented. The valve between the stout-chambered left ventricle and auricle does not present this structure, but is divided into two or three lobes attached to tendinous processes. At the origin of the great vessels—the pulmonary artery and the aorta—there are three valves, semi-lunar in shape and by name. And this last vessel, often having given off the coronary artery to the heart itself, is curved to the right, and then passes backwards to go down the body. The blood from the body is collected into three large veins—two anterior *venæ cavæ* and one posterior.

The lymphatic system is well developed, and of the so-called "lymphatic hearts," which are well known in the Frog, the posterior ones have been observed in some, and especially in the Ratite birds.

The lungs, or organs in which the blood effects an exchange of its gases with the outer air, are paired, and set on either side of the heart. As is elsewhere mentioned, the nostrils are not provided with muscles, and there is no *epiglottis* sufficiently well developed to cover the entrance into the long tube, or *trachea*, which runs down the neck. This tube, which does not always take a straight course, is essentially made up of a number of rings of cartilage, which are for the greater part perfect, and not, as in man, imperfect rings. The *bronchi* which are given off from this tube, to the right and left, have their rings imperfect, and they do not show that two-forked mode of division which is so characteristic of mammals. The lungs are of a rosy colour, and of a comparatively small volume; they are marked externally by depressions corresponding to the characters of the vertebræ and ribs, to which latter they are firmly attached, and they are not divided into *lobes*: in their texture they are spongy; the air-tubes are given off from them at right angles to the main air-passage; these run nearly parallel to one another, and contain in their walls the true tissue of the respiratory organ. The air-tubes are also connected with the air-cells, which are arranged in so remarkable a manner as to deserve a full account.

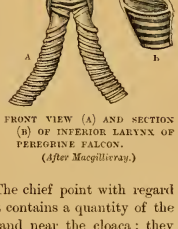
They are found in all birds with the exception of the *Apteryx*, according to Professor Owen. Our knowledge of their existence is primarily due to the illustrious William Harvey, while it is to the distinguished anatomist, John Hunter, that we owe our knowledge of the very curious fact that these air-passages and sacs are not by any means highly vascular, or supplied with vessels to the same rich extent as are the lungs, they are nevertheless of enormous importance to the bird; thus, they diminish the specific gravity of the animal. For example, taking a bird which weighs 1,600 grammes, and has a volume of 1,230 cubic centimetres —or a specific gravity of 1·30 $(\frac{1600}{1230})$ it has been calculated (Bert) that 200 cubic centimetres of air can be introduced; now these centimetres would weigh ·22 of a gramme, so that the specific gravity of the animal would be reduced to 1·05 $(\frac{1600+0\cdot22}{1230+200})$ or $(\frac{1600\cdot22}{1520})$. Again, the air which is taken into the lungs is, in high-flying birds, often of an extremely low temperature; but this air is not only brought into contact with that of the lungs, but also with that which has been warmed in the abdominal cavity. And again, the air is often very dry—as it is for the Ostrich on the desert plains of Africa—but the air from the air-sacs contains a large amount of moisture. Of the proper air-sacs there are nine; of these, four—the two anterior and the two posterior *thoracic*—lie in the thorax (breast) proper; three—the right and left cervical, and the sac between the *clavicles*—lie in front of the thorax; while the last two are found behind it and in the abdomen. From all of these, with the exception of those within the thorax, communications are, or may be, given off to the bones of the vertebral column, to the humerus, to the bones of the thigh, and to the sternum and the ribs; but there is no communication between these sacs and the air-spaces which are so constantly found in the bones of the skull, and which are in connection with the air-cavities of the ear and of the nose. The inter-clavicular sac has been observed to be covered with a thick layer of muscle in those birds, at any rate, which perform somersaults, and it has been suggested that this layer of muscle is capable of driving the air in the sac backwards. It is obvious that such an operation would send the centre of gravity of the animal nearer the head, and would, so far, be of assistance in the execution of the curious movement alluded to.

It has been suggested that the air-sacs are of assistance in increasing the resonance of the bird's voice. Be this as it may, attention must now be turned to the organ of voice. This organ may take one of three forms, or, if absence is to be counted, four. There is no organ of voice in the Ratitæ, or in the American Vultures (*Cathartidæ*). It is, when present, remarkable for being developed at the lower, and not at the upper, end of the *trachea*; while the true *vocal cords*, which,

by their vibration produce the notes of the human voice, are altogether and always absent from the larynx; in other words, the vocal organ is not the *larynx*, but an organ seated at a lower level, and known as the *syrinx*. This instrument may, further, be formed in the trachea alone (as in some American Passerines), or in the bronchi alone (as in Steatornis), or at the point at which the tracheal and bronchial tubes pass into one another (as in the majority of singing birds).

The last-mentioned, or *bronchio-tracheal syrinx*, consists of the following parts; (i.) a *tympanic* chamber formed by the union of some of the lower rings of the trachea; (ii.) a membranous *septum* separating from one another the tracheal orifices of the two bronchi; (iii.) on either side a *tympaniform membrane*, formed on the inner side of the uppermost bronchial rings; in consequence of this these bronchial rings are not complete circles; their mucous membrane is developed into a fold which bounds one side of a cleft which is formed by the presence on the other side of the above-mentioned tympaniform membrane. The air which passes through these bronchial clefts sets in vibration the membranes which bound them, while the character of the note is affected by the position of the bronchial half-rings, and the length of the column of air in the trachea. These rings have their positions changed by five lateral muscles, which act on their ends, and so rotate them. The principle variations in the characters of the muscular supply of the organ of the voice were long ago worked out by Johannes Müller, the famous German anatomist and physiologist.

It is also to this observer that we owe our first information with regard to the bronchial syrinx of Steatornis; the anatomy of this animal was also investigated by the late Prof. Garrod, who gave the following account of its vocal apparatus:—"Each semi-syrinx, as it may be termed, is formed on the same principle as that of the combined organ in most of the non-singing birds. Taking for description that of the left side, it is found that the thirteenth bronchial ring is complete, though considerably flattened from side to side; the fourteenth is not complete in the middle of its upper surface; it is a little longer from before backwards than the one above, and not so long as the one following it. The fifteenth is only a half ring, its inner portion being deficient; it is slightly convex upwards, and articulates, both at its anterior and posterior ends, with the fourteenth incomplete ring and the sixteenth half-ring. The sixteenth half-ring is concave upwards, and so forms an oval figure in combination with the one above, which is filled with a thin membrane to form part of the outer wall of the bronchus. There is a membrane also between the ends of these and the succeeding half-rings, which completes the tube of the bronchus internally."



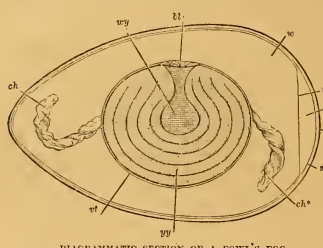
FRONT VIEW (A) AND SECTION (B) OF INFERIOR LARYNX OF PEREGRINE FALCON.
(*After Macgillivray.*)

The ducts from the urinary organs open to the exterior through the cloaca, into which, as already mentioned, the digestive tube also opens. The chief point with regard to the urinary secretion of birds is the fact that it is *semi-solid*, and that it contains a quantity of the substance known as *uric acid*. The kidneys are placed some way back and near the cloaca; they are set on either side of the spinal column, between the transverse processes of the sacral vertebræ, and are generally divided into three portions of greatly varying size. On their inner edge are given off the *ureters*, which pass on each side to enter separately into the before-mentioned cloaca.

The right ovary of birds is always atrophied, and it is in rare cases only that rudiments of it are found (namely, in the diurnal Raptores). The *oviduct* is a coiled canal, the lower portion of which has strong, muscular walls, while internally the characters of its surface vary according to the substance which the glands of different regions add to the descending egg. The right oviduct is not so completely atrophied as is the ovary of the same side. This duct opens into the cloaca through which the egg passes to reach the outer world; as further development is so largely independent of the mother, the female organs offer no peculiarities of arrangement, or complexities of structure.

All birds lay eggs, or, in other words, the born young are not carried about by the mother till the time of birth. The advantage of this to a flying animal is so obvious that we may pass at once to describe the egg of a common fowl. The shell, which consists of organic matter and lime-salts, is found to be formed of two layers; it is in the outer one only that pigment is found. Both layers are traversed by canals, through which air can pass only when the shell is dry;

that is to say, the outer pores of the shell are closed under the influence of moisture. This may be seen by removing the outer layers, when air or water will pass in quite easily. These canals are said to be branched in the Ratite birds, and to be simple in the Carinatæ. The shell is lined by the shell-membrane, which, again, is made up of two layers. At the broad end of the egg these two layers are separated from one another, and so give rise to that air-chamber which is found in stale eggs, and increases in size as the egg grows older and the yolk evaporates.



DIAGRAMMATIC SECTION OF A FOWL'S EGG.
(bd) Blastoderm; (wy) White Yolk; (yy) Yellow Yolk; (vt) Vitelline Membrane; (w) Albumen; (ch) Chalazæ; (ach) Air-chamber; (iem) Internal Layer of Shell Membrane; (em) External Layer of ditto; (s) Shell.

The shell-membrane is in direct contact with the *white* of the egg (*albumen*). This, in its fresh state, consists of fluid albumen, arranged in layers, which are separated from one another by networks of fibres, in the meshes of which, however, fluid albumen is also to be found. There are, further, two special sets of fibrous cords in the white of the egg; these extend somewhat along the long axis of the egg, though they do not reach to the shell-membrane. From their bead-like character they are known as *chalazæ* (hailstones), but their more common English name is that of the "tread."

The "white" is separated from the *yolk* by the so-called *vitelline* (or *yolk*) membrane; the greater part of this yolk is known as the *yellow yolk*, and is made up of minute albuminous granules, but its outermost part is formed of a thin layer of a somewhat different substance, which goes by the name of the *white yolk*. The spheres of this latter are still smaller than those of the yellow yolk, and they are also found to form layers at various levels in it. At one point the white yolk becomes a good deal thicker, and forms, as it were, a pad for a small white disc, which, in ordinary circumstances, is always found uppermost when an egg is opened. This disc is formed of an encircling white rim, and within it there is a rounded transparent region, the centre of which is more opaque.

This region is known as the *blastoderm*, and is that part of the egg from which the chick, with its organs and complicated vessels, muscles and bones is soon to be developed. In the laid egg, this blastoderm consists of two layers of cells, as do at a certain stage the eggs of all but the very simplest of animals. The dissection of a laying fowl will probably reveal the presence of eggs at an earlier stage, and from their study the following history has been made out: the ellipse-shaped egg, when about to leave the ovary, is a yellow body enclosed in a fine membrane, and possessing at one pole a small (*germinal*) disc; this disc contains a smaller *germinal vesicle*, and a still smaller *germinal spot*; when this body is ripe, it escapes from its enclosing capsule, and the germinal vesicle disappears. As the egg passes down the *oviduct* the albumen becomes deposited around it, and part of it is converted into the shell-membrane. The egg now becomes subjected to a thick, white fluid, which is gradually converted into the shell.

While these additions to the substance of the egg are going on, the germinal disc undergoes the remarkable process known as segmentation, in which it becomes divided into two, four, eight, sixteen, thirty-two (and so on) masses, which arrange themselves in two distinct layers, the presence of which has been already noted in the laid egg.

This is not the place in which it is possible to follow out the various future changes undergone, but the condition of the young birds on escaping from the egg is widely different in some of the larger groups of birds. Some young birds, on their exclusion from the egg, are able to shift for themselves, and are covered with down; while others are born naked and helpless, and require food from their parents for some time after they are hatched. Of the first section, an ordinary chicken is a familiar example, while a young Thrush or a Sparrow illustrates the second. There are, however, manifest exceptions to this rule, as in the Herons, for instance, where the young are densely clothed with feathery down, but are helpless for a long time after they are hatched.

Finally, it must be stated that all birds possess an oil-gland (known as the uropygial), situated

near the tail, with which they clean and dress their feathers. Attention has already been called to this gland in the foot-note on p. 245.

Before commencing the special part of the present article, it may be useful to give a slight sketch of the classification which it is proposed to follow throughout its course.

CLASS AVES.

DIVISION I.—CARINATÆ: CARINATE BIRDS.

ORDER I.—ACCIPITRES: BIRDS OF PREY.

SUB-ORDER I.—FALCONES: FALCONS.

Family I.—Vulturidæ - - - - - Vultures.
,, II.—Falconidæ - - - - - Hawks.
Sub-Family I.—Polyborinæ - - Caracaras.
,, II.—Accipitriinæ - - Long-legged Hawks.
,, III.—Buteoninæ - - Buzzards.
,, IV.—Aquilinæ - - - Eagles.
,, V.—Falconinæ - - - Falcons.

SUB-ORDER II.—PANDIONES: OSPREYS.

SUB-ORDER III.—STRIGES: OWLS.

Family I.—Bubonidæ - - - - - Owls proper.
,, II.—Strigidæ - - - - - Barn Owls.

ORDER II.—PICARIÆ: PICARIAN BIRDS.

SUB-ORDER I.—ZYGODACTYLÆ: CLIMBING BIRDS.

Family I.—Psittaci - - - - - Parrots.

a.—*Psittaci proprii.*

Sub-Family I.—Camptolophinæ - Cockatoos.
,, II.—Androglossinæ - Fleshy-tongued Parrots.
,, III.—Conurinæ - - - Conures.
,, IV.—Platycercinæ - - Parrakeets.
,, V.—Strigopinæ - - Owl Parrots.

b *Psittaci orthoglatthi.*

,, VI.—Trichoglossinæ - { Brush-tongued Parrots.

Family II.—Cuculidæ - - - - Cuckoos.
,, III.—Indicatoridæ - - - Honey-guides.
,, IV.—Musophagidæ - - - Touracoes.
,, V.—Picidæ - - - - - Woodpeckers.
,, VI.—Rhamphastidæ - - - Toucans.
,, VII.—Capitonidæ - - - - Barbets.

SUB-ORDER II.—FISSIROSTRES: WIDE-GAPING BIRDS.

Family I.—Galbulidæ - - - - Jacamars.
,, II.—Bucconidæ - - - - Puff Birds.
,, III.—Alcedinidæ - - - - Kingfishers.
,, IV.—Bucerotidæ - - - - Horn-bills.
,, V.—Upupidæ - - - - Hoopoes.
,, VI.—Meropidæ - - - - Bee-eaters.
,, VII.—Momotidæ - - - - Motmots.
,, VIII.—Coraciadæ - - - - Rollers.
,, IX.—Trogonidæ - - - - Trogons.
,, X.—Caprimulgidæ - - - Goatsuckers.
,, XI.—Cypselidæ - - - - Swifts.
,, XII.—Trochilidæ - - - - Humming-birds.

ORDER III.—PASSERIFORMES: PERCHING BIRDS.

SECTION A.—ACROMYODI: SINGING BIRDS.

SUB-ORDER I.—TURDIFORMES: THRUSH-LIKE BIRDS.

GROUP I.—COLIOMORPHÆ: CROW-LIKE PASSERES.

Family I.—Corvidæ - - - - - Crows.
Sub-Family I.—Corvinæ - - - Crows proper.
,, II.—Fregilinæ - - - Choughs.
Family II.—Paradisiidæ - - - - Birds of Paradise.
,, III.—Oriolidæ - - - - Orioles.
,, IV.—Dicruridæ - - - - Drongos.
,, V.—Prionopidæ - - - - Wood-shrikes.

GROUP II.—CICHLOMORPHÆ: THRUSH-LIKE PASSERES.

Family VI.—Campophagidæ - - - Cuckoo-shrikes.
,, VII.—Muscicapidæ - - - Flycatchers.
,, VIII.—Turdidæ - - - - - True Thrushes.
Sub-Family I.—Turdinæ - - - Thrushes.
,, II.—Sylviinæ - - - Warblers.
Family IX.—Timeliidæ - - - - Babbling Thrushes.
Sub-Family I.—Troglodytinæ - Wrens.
,, II.—Brachypodinæ - Bulbuls.
,, III.—Timeliinæ - - - Babblers.
,, IV.—Cisticolinæ - - - Grass-warblers.
,, V.—Miminæ - - - American Babblers.
Family X.—Laniidæ - - - - - Butcher-birds.
,, XI.—Vireonidæ - - - - - Greenlets.
,, XII.—Paridæ - - - - - Titmice.

GROUP III.—CERTHIOMORPHÆ: CREEPERS.

GROUP IV.—CINNYRIMORPHÆ: HONEY SUCKERS.

SUB-ORDER II.—FRINGILLIFORMES: FINCH-LIKE BIRDS.

Family I.—Motacillidæ - - - - Wagtails.
,, II.—Mniotiltidæ - - - - American Warblers.
,, III.—Certhiidæ - - - - American Creepers.
,, IV.—Dicæidæ - - - - Flower-peckers.
,, V.—Ampelidæ - - - - Chatterers.
,, VI.—Hirundinidæ - - - Swallows.
,, VII.—Tanagridæ - - - Tanagers.
,, VIII.—Fringillidæ - - - Finches.
,, IX.—Icteridæ - - - - Hang-nests.

SUB-ORDER III.—STURNIFORMES: STARLING-LIKE BIRDS.

Family I.—Ploceidæ - - - - Weavers.
,, II.—Sturnidæ - - - - Starlings.
,, III.—Artamidæ - - - - Wood-swallows.
,, IV.—Alaudidæ - - - - Larks.

SECTION B.—MESOMYODI: SONGLESS BIRDS.

Family I.—Menuridæ - - - - Lyre-birds.
,, II.—Pteroptochidæ - - - Bush-wrens.
,, III.—Dendrocolaptidæ - - Spine-tails.
,, IV.—Formicariidæ - - { American Ant-thrushes.
,, V.—Pittidæ - - - - { Old-World Ant-thrushes.
,, VI.—Tyrannidæ - - - - Tyrant-birds.
,, VII.—Cotingidæ - - - - American Chatterers.
,, VIII.—Pipridæ - - - - Manakins.
,, IX.—Eurylæmidæ - - - Broadbills.
,, X.—Phytotomidæ - - - Plant-cutters.

ORDER IV.—COLUMBÆ: PIGEONS.

ORDER V.—GALLINÆ: GAME-BIRDS.

Family I.—Cracidæ - - - - - Curassows.
,, II.—Opisthocomidæ - - - Hoatzins.
,, III.—Phasianidæ - - - - Pheasants.
,, IV.—Meleagridæ - - - - Turkeys.
,, V.—Tetraonidæ - - - - Grouse.
,, VI.—Pteroclidæ - - - - Sand-grouse.
,, VII.—Turnicidæ - - - - Hemipodes.
,, VIII.—Megapodidæ - - - - Megapodes.

ORDER VI.—GRALLÆ: WADING BIRDS.

Family	I.—Rallidæ	Rails.
,,	II.—Scolopacidæ	Snipes.
,,	III.—Charadriidæ	Plovers.
,,	IV.—Otididæ	Bustards.
,,	V.—Gruidæ	Cranes.
,,	VI.—Psophiidæ	Trumpeters.

ORDER VII.—HERODIONES: HERONS.

Family	I.—Ardeidæ	Herons proper.
,,	II.—Ciconiidæ	Storks.
,,	III.—Plataleidæ	Spoonbills.
,,	IV.—Phœnicopteridæ	Flamingoes.

ORDER VIII.—ANSERES: GEESE.

Family	I.—Palamedeidæ	Screamers.
,,	II.—Anatidæ	Ducks.

ORDER IX.—STEGANOPODES: PELICANS.

Family	I.—Fregatidæ	Frigate-birds.
,,	II.—Phæthontidæ	Tropic-birds.
,,	III.—Pelecanidæ	Pelicans.

ORDER X.—GAVLÆ: SEA-BIRDS.

Family	I.—Laridæ	Gulls.
,,	II.—Procellariidæ	Petrels.

ORDER XI.—PYGOPODES: GREBES.

ORDER XII.—IMPENNES: PENGUINS.

ORDER XIII.—CRYPTURI: TINAMOUS.

DIVISION II.—RATITÆ: STRUTHIOUS BIRDS.

DIVISION III.—SAURURÆ: LIZARD-TAILED BIRDS.

It has been already stated that birds are divisible into three great sections, and attention is now directed to those which have a keel to the sternum, and which are good flyers—the Carinate Birds (CARINATÆ).

CHAPTER III.

DIVISION I.—THE CARINATE BIRDS (CARINATÆ).

THE ACCIPITRINE ORDER—BIRDS OF PREY.

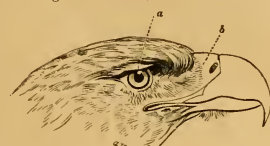
VULTURES AND CARACARAS.

The Birds of Prey—Distinctive Characters—The Cere—How the Birds of Prey are Divided—Difference between a Hawk, an Owl, and an Osprey—The three Sub-orders of the Accipitres—Sub-order FALCONES—Difference between the Vultures of the Old World and the Vultures of the New World—THE OLD WORLD VULTURES—Controversy as to how the Vultures reach their Prey—Waterton on the Faculty of Scent—Mr. Andersson's, Dr. Kirk's, and Canon Tristram's Views in Favour of Sight—THE BLACK VULTURE—THE GRIFFON VULTURE—Its Capacity for Feeding while on the Wing—THE EARED VULTURE—One of the Largest of the Birds of Prey—Whence it gets its Name—THE EGYPTIAN VULTURE—A Foul Feeder—THE NEW WORLD VULTURES—THE CONDOR—Its Appearance—Power of Flight—Habits—THE KING VULTURE—THE TURKEY VULTURE—THE CARACARAS—Distinctive Characters—Habits—THE SECRETARY BIRD—How it attacks Snakes—Habits—Appearance—THE ÇARIAMA.

THE first order of birds to be considered is the birds of prey (*Accipitres*). They are all remarkable for strong and sharply-hooked bills, and most of them have sharp and powerful talons. In the Eagles and Falcons these characters are developed in the highest degree, although many modifications of their structure take place in the order—the Vultures, for instance, and other carrion-feeding birds, not having such a hooked bill as the true Falcons and Eagles, while their feet are larger and more adapted for holding their prey than for striking it down in full career, as the Falcons do. In most of the birds of prey the female is larger than the male, and is much the more powerful bird. This fact is always recognised in falconry, especially in the short-winged Hawks, such as Sparrow-Hawks or Goshawks, whose females are always preferred, as possessing the greater power for holding ground game, such as Rabbits, Hares, &c. The difference in size is not very noticeable in the Vultures, but is unmistakable in the long-legged Sparrow-Hawks, Eagles, and Falcons. The form of the breast-bone, which plays such an important part in the classification of other birds, is a character of less value in the birds of prey, as it varies to a great extent even in those species which, by their habits and general structure, are most closely allied. Another character possessed by these birds is the distinct *cere*, which is present in all, though much hidden by bristles in the Owls: it is a waxy covering to the base of the bill, often hard, but generally fleshy in substance.

Birds of prey are of three kinds: Hawks, Ospreys, and Owls. Under the first name is included every rapacious bird which is not an Osprey or an Owl, and, therefore, the first thing to find

out is—how to tell an Owl from a Hawk. At one time it was supposed that all Owls came out by night and all Hawks by day, and so they were separated into two great divisions, which were called diurnal birds of prey* and nocturnal birds of prey.† Now, however, that the habits of birds are getting better observed, these divisions have to be abandoned as not being entirely true, for there are Owls which are quite at home in the daylight, when they hunt for their food like any other bird of prey, and at least one kind of Hawk is known, whose habit it is to feed on Bats in the evening. This is Andersson's Pern,‡ a kind of Kite, allied to the Honey-kite of England. It is found only in the Damara Country, in South-western Africa, and in Madagascar. A far better way to distinguish Hawks from Owls is seen in the foot, as the latter have the outer toe reversible—that is to say, they can turn their outer toe backwards or forwards as they please. This is easily observed in the living birds; and any one examining a caged Owl in the Zoological Gardens will see that it sits with its toes in pairs—two in front and two behind. A Hawk cannot do this, all his toes being arranged as in a little perching bird, such as a Sparrow or a Canary, three in front and one behind. Then, again, Owls have no "after-shaft" to the feathers, a structure which most Hawks possess. The "after-shaft" is the small accessory plume, which springs from the under-side of the main feather. In some birds it is very large, in others small. It occurs on the body feathers only, and is never found in the quills or tail feathers (see p. 238). Lastly, in addition to the reversible outer toe, and the absence of an accessory plume or after-shaft, Owls may be distinguished from all other birds of prey, save one, by the proportions of their leg-bones. In the skeleton figured on p. 241 the three principal leg-bones are pointed out; and it is the length which the tarsus bears in proportion to the tibia that is here insisted on. In the Owls the tarsus is only about half the length of the tibia; this is never the case in a Hawk, in which these two bones bear different proportions the one to the other, according to the sub-family. Thus in Sparrow-Hawks and Harriers § the tibia and the tarsus are equal in length. In Eagles and Buzzards, Kites and true Falcons, the tibia is always much longer than the tarsus, but is never double its length, as it is in the Owls. The term "Hawk," which has been employed throughout the foregoing sentences, is intended to apply to every bird of prey excepting the Owls, with the sole exception of the Osprey. The habits of the Osprey are noticed later on, but they may be briefly stated to be similar to those of a Sea-Eagle, its prey consisting entirely of fish, while its plumage and general appearance are also those of an Eagle, so that in many places it is popularly known as the "Fish Hawk," or "Fishing Eagle;" but here the resemblance of the Osprey to the Eagle ends, and in its other characters it is very like an Owl. The tibia is more than double the length of the tarsus, as in the Owls; the feathers of the body have no after-shaft, as in the Owls, and the outer toe is reversible, as in the Owls. Possessing, therefore, as it does, some of the most prominent features of the Eagles, as well as some of the most striking peculiarities of the Owls, the Osprey holds an intermediate position between these two sub-orders of birds.



HEAD AND BILL OF SEA EAGLE. (*After Keulemans.*)
(*a*) bony eye-shelf; (*b*) cere.

The birds of prey, then, may be separated into three sub-orders:—

(*a*). Outer toe *not* reversible; tibia varying in length in proportion to the tarsus, sometimes equal to it, but never double the length of the latter; body feathers *with* an after-shaft or accessory plume. (American Vultures excepted.)

I. Hawks (*Falcones*).‖

(*b*). Outer toe *reversible;* tibia double the length of tarsus; body feathers *without* an after-shaft or accessory plume; plumage compact, as in an Eagle: no facial disk.

II. Ospreys (*Pandiones*).¶

(*c*). Outer toe *reversible;* tibia double the length of tarsus; body feathers *without* an after-shaft; plumage soft and fluffy; a facial disk.

III. Striges;** Owls.

* *Accipitres diurni* of authors. † *Accipitres nocturni* of authors. ‡ *Machærhamphus Anderssoni*. § *Accipitrinæ*
‖ *Falco*, a Falcon. ¶ Πανδίων, a Greek mythological name. ** στρίγξ, an Owl.

The Falcones, or Hawks, include in their number more kinds of rapacious birds than the other two sub-orders. All the Vultures, the Caracaras, the Harriers, the Sparrow-Hawks, the Buzzards, Eagles, Kites, and Falcons, together numbering some four hundred different species, are classified as *Falcones*. Only one species of Osprey is known, which is found nearly all over the world; and about two hundred different kinds of Owls remain to represent the STRIGES.

ORDER ACCIPITRES.—SUB-ORDER FALCONES.

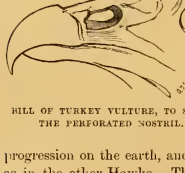
The first sub-order is divided into two families, the first to be noticed being the Vultures (*Vulturidæ*), which is again sub-divided into two sections, the Vultures of the Old World (*Vulturinæ*) and the Vultures of the New World (*Sarcorhamphinæ*).

THE FIRST SUB-FAMILY OF THE VULTURIDÆ.—THE OLD WORLD VULTURES (*Vulturinæ*).

These Vultures are neither to be recommended for their habits nor for their personal appearance. In fact, in both these respects they are rather repulsive birds, but useful withal in hot climates, where they act as scavengers, and clear away much putrid matter and decaying substances, which but for their intervention would prove most offensive. They are all inhabitants of tropical, or at least of warm, countries; and it is only on rare occasions that they wander into the North of Europe or occur in the British Islands. Both the Old and the New Worlds have their Vultures, but the naturalist has no difficulty in telling at a glance to which hemisphere the bird he is looking at belongs, for all the Vultures of the New World have *a hole through their nose*—or, in other words, want the wall of bone which divides one nostril from the other; in the Vultures of the Old World this bony wall is present so that the nostrils resemble those of other ordinary birds.

BILL OF EGYPTIAN VULTURE, TO SHOW FORM OF NOSTRIL. (*After Keulemans.*)

Besides their perforated nostril, the American Vultures differ from the Old World species in having no after-shaft to the feathers, therein resembling the Owls. This character has led some naturalists to consider the New World Vultures as constituting a separate family, which bears the name of *Cathartidæ*; but although the absence of an after-shaft is a striking feature, yet the habits of the birds so closely resemble those of their Old World cousins, that it seems unnatural to separate them widely in any scheme of classification. The head of a Vulture, whatever locality he may be from, proclaims the nature of the bird at once, as it is always bare of feathers, or nearly so: sometimes a few scattered tufts of down are seen on the head and neck, but never any true feathers, as in the case of the other birds of prey. The Vultures feed on the ground, where they walk with comparative ease, their large feet being fitted for progression on the earth, and their toes not being prehensile or capable of bending to the same extent as in the other Hawks. This formation of the foot prevents them from striking down or snatching their prey, as an Eagle or a Hawk would do; and they do not carry food to their young, but devour the carcase or carrion where it falls, and then feed the nestlings by throwing up food from their crop. They are all birds of powerful flight, and are capable of sustaining a prolonged soar in the air without any apparent motion of the wings.



BILL OF TURKEY VULTURE, TO SHOW THE PERFORATED NOSTRIL.

As to the way in which Vultures discover their prey, the opinion of naturalists has for a long time been divided, and controversy has waxed hot upon the subject, the question being whether the Vulture possesses a more than usually keen sense of sight, or whether his sense of smell is so powerful as to enable him to scent a decaying carcase at a greater distance than other birds can do. The experiments of various travellers seem to prove that both the senses of sight and smell are possessed by the Vulture in no ordinary degree; but the balance of evidence seems to prove that it

is by their keen sight that they generally find their food. Supposing that an animal is wounded, and escapes from the hunter, his course is marked by a Vulture soaring high in the air; another circling far away on the horizon sees the first bird fly down, and follows in his track; and so on, until a large company is feeding on the carcase. This action of the Vultures is well described by Longfellow:—

"Never stoops the soaring Vulture
On his quarry in the desert,
On the sick or wounded Bison,
But another Vulture, watching
From his high aërial look-out,
Sees the downward plunge, and follows;
And a third pursues the second,
Coming from the invisible ether,
First a speck, and then a Vulture,
Till the air is dark with pinions."*

The power of the Vulture's sight was long disputed by the former generation of naturalists, and the celebrated Waterton wrote an article on the "Faculty of Scent in the Vulture,"† to prove that it was more by this means than by sight that the bird was able to discover a carcase. Waterton was well acquainted with Vultures in Demarara and in Southern Spain, and he sums up his argument as follows:—"After the repeated observations I have made in the country where it abounds, I am quite satisfied that it is directed to its food by means of its olfactory nerves coming in contact with putrid effluvium, which rises from corrupted substances through the heavier air. Those are deceived who imagine that this effluvium would always be driven to one quarter in the tropics, where the trade-winds prevail. Often, at the very time that the clouds are driving from the north-east up above, there is a lower current of air coming from the quarter directly opposite. This takes place most frequently during the night-time, in or near the woods; and it often occurs early in the morning, from sunrise till near ten o'clock, when the regular trade-wind begins to blow. Sometimes it is noticed in the evening, after sunset; and now and then during the best part of the day in the rainy season. . . . Vultures, as far as I have been able to observe, do not keep together in a large flock when they are soaring up and down in quest of a tainted current. Now, suppose a Mule has just expired behind a high wall, under the dense foliage of evergreen tropical trees; fifty Vultures, we will say, roost in a tree a mile from this dead Mule. When morning comes, off they go in quest of food. Ten fly, by mere chance, to the wood where the Mule lies, and manage to spy it through the trees; the rest go quite in a different direction. How are the last-mentioned birds to find the Mule? Every minute carries them farther from it. Now reverse the statement; and instead of a Mule nearly dead, let us suppose a Mule in an offensive state of decomposition. I would stake my life upon it that not only the fifty Vultures would be at the carcase next morning, but also that every Vulture in the adjacent forest would manage to get there in time to partake of the repast." It will be seen from the above that Mr. Waterton allowed the keen sight of the Vultures to play, on some occasions, a part in their discovering food. Another observation on this subject is contained in the late Mr. C. J. Andersson's work on the ornithology of South-western Africa. Writing on the Sociable Vulture (*Otogyps auricularis*), he says:—"I believe naturalists are not quite agreed as to whether Vultures hunt by sight, by scent, or by both faculties combined. I have myself no doubt that they employ the one sense as well as the other in finding their prey, though I feel inclined to give sight the preference; and I once had a very striking proof of how they employ their vision in guiding them to carrion—in this instance, however, not so much by the actual sight of the carrion (though the first discovery probably originated in that way) as by another singular contrivance. Early one morning, as I was toiling up the ascent of a somewhat elevated ridge of hills, with the view of obtaining bearings for my travelling map, and before arriving at the summit, I observed several Vultures descending near me: but thinking I had merely disturbed them from their lofty perch, I did not take any particular notice of their appearance, as the event was one of usual occurrence; but on gaining my destination, I found that the birds were not coming merely from the hill summit, but from an indefinite distance on the other side. This circumstance, coupled with the fact that I had wounded a Zebra on the preceding day in the direction towards which the Vultures were winging their way, caused me to pay more attention. The flight of the Vultures was low—at least five hundred to a thousand feet below the summit of the mountain; and on arriving near the base, they would abruptly rise without deviating from their direct course;

* "Song of Hiawatha," Book XIX.

† "Essays on Natural History," 1866, p. 17.

and no sooner was the obstacle in their way thus surmounted than they again depressed their flight. Those Vultures which I saw could not have themselves seen the carrion, but simply hunted in direct sight of one another. There was a numerous arrival; and although I could not always detect the next bird as soon as I had lost sight of the previous one, yet, when at length it did come into view, it never seemed uncertain about its course. Having finished my observations, I descended, and proceeded in the direction which the Vultures had pursued; and after about half an hour's rapid walking, I found, as I anticipated, the carcase of a Zebra, with a numerous company of Vultures busily discussing it."*

Dr. Kirk, the companion of Livingstone, in his paper on the "Birds of the Zambesi Region of Eastern Tropical Africa,"† says that to the inexperienced hunter the Griffon is "a great annoyance. If game be left for an hour in the open plain while the men come to carry it off, the birds will descend, and in a very short time completely devour it. This is not so if it be covered over with a little grass or with branches, clearly proving that sight alone is the sense by which the birds discover their prey. If part of the animal be exposed it matters not—probably owing to its being mistaken for one asleep; nor does the presence of blood seem to guide the birds if the carcase be concealed from view."

Lastly, to quote from Canon Tristram's interesting essay on the "Ornithology of the Sahara:"‡ "As, happily for the traveller, Camels do not die every day under the weight of their water-skins, the Griffon does not habitually visit the desert. Still, he occasionally gives it a passing call, though, if his meal be deposited near an oasis, he is usually forestalled by the Hyæna ('Dubba,' Arab.), who lurks in the 'weds.' On one occasion a Camel in our caravan having become footsore had to be slaughtered on the spot. Our attendants selected the tenderest morsels for 'kouskous,' the Arab broth; and it was not until the next morning that a Vulture scented, or rather descried, his prey. That the Vulture uses the organ of sight rather than that of smell, seems to be certain from the immense height at which he soars and gyrates in the air. In this instance one solitary bird descended, and half an hour afterwards was joined by a second. A short time elapsed, and the Nubian Vulture (*Otogyps nubicus*) appeared, self-invited, at the feast; and before the bones were left to the Hyæna no less than nine Griffons and two Nubians had broken their fast. I should hesitate to assert that they had satisfied their appetites. I have observed the same regular succession of diners out on other occasions. May we not conjecture that the process is as follows? The Griffon who first descries his quarry descends from his elevation at once; another, sweeping the horizon at a still greater distance, observes his neighbour's movements and follows his course; a third, still farther removed, follows the flight of the second; he is traced by another; and so a perpetual succession is kept up as long as a morsel of flesh remains over which to consort. I can conceive no other way of accounting for the numbers of Vultures which in the course of a few hours will gather over a carcase, when previously the horizon might have been scanned in vain for more than one, or at the most two, in sight. Does not this explain the immense number of Vultures who were congregated in the Crimea during the siege of Sebastopol, where the bird was comparatively scarce before? May not this habit of watching the movements of their neighbours have collected the whole race from the Caucasus and Asia Minor to enjoy so unwonted an abundance? The Arabs believe that the Vultures from all North Africa were gathered to feed on Russian Horses in the Crimea, and declare that during the war very few 'Nissr' were to be seen in their accustomed haunts."

The above extracts from authentic works have been made at some length, as exhibiting the general habits of the Vultures. It remains now to notice some of the most striking forms of these birds.

THE BLACK VULTURE §

This is an inhabitant of Southern Europe, whence it extends on both sides of the Mediterranean to North-western India, where it is a cold weather visitant, and even to China. In its habits this bird is rather unsociable, and keeps more to the wooded districts, seldom venturing into the open country, except when attracted by the presence of some carcase, on which it feasts in company with the Griffon Vulture. It breeds on trees, constructing a large bulky nest, and only selects a rock for its

* "Notes on the Birds of Damara Land and the adjacent countries of South-west Africa," 1872, p. 3.
† 1864, p. 307. ‡ 1859, p. 277. § *Vultur monachus.*

breeding home when there are no trees to be found in the neighbourhood. It lays one egg, of a richly mottled red colour, two eggs being an extremely rare occurrence. In appearance they are very like those of the Golden Eagle. A story is told of the rescue by a pair of old birds of their young ones, which were in danger from the felling of the tree on which the nest was situated. It is thus related by Count von Tshusi Schmidthofen:—"The royal forester, A. Fikker, found in 1860, on the top of a giant beech in the valley of Dobrabach, in the Sinnaer district, the nest of this Vulture. When the young birds were large enough to be able to save themselves as the tree fell, orders were given to cut the beech down. The wood-cutters had worked at the tree some time, when the old birds appeared, uttering loud cries, and suddenly pounced on the nest, caught hold of the young ones

GRIFFON VULTURE.

in their claws and disappeared like lightning, carrying off the young (who loudly complained of the unusual mode of locomotion) before the gaze of the astonished spectators."

The Black Vulture measures three feet and a half in length, and is entirely black, the bare places on the head and neck being of a livid flesh colour when the bird is alive.

THE GRIFFON VULTURE.*

The Griffon, or Fulvous Vulture (so called from its colour), is found all over Southern Europe, and occurs occasionally at different points in Central Europe, having once been taken in the British islands off Cork Harbour; it therefore figures in the list of British birds. It ranges all over North-eastern Africa, and extends eastwards into Turkestan, Central Asia, and North-western India. As it goes eastwards the Griffon becomes a more rufous bird, and is by some naturalists considered to be a different species. In the British Museum is a very interesting specimen of this Vulture, collected by Major Denham in Bornou during his travels across Africa, being one of the comparatively few birds that have been brought from Central Africa, about the ornithology of which we do not even yet know

* *Gyps fulvus.*

much. Like other Vultures, the Griffon feeds on carrion, but is also stated to frequent the sea-shore in search of Crustacea and dead fish; while the South African Griffon is said to feed on Locusts and small Tortoises, the latter of which it swallows whole.*

This bird's capacity for feeding is illustrated in a most amusing anecdote of Canon Tristram's:—"For some months we possessed two Griffons taken from the nest, who at length arrived safely in England. They never attempted to leave us, differing in this respect from our Lämmergeiers, but remained contentedly about the tents or perched on the backs of the baggage-camels *en route*. They took a peculiar interest in taxidermy, scrutinising, head on one side, the whole operation of bird-skinning, and perfectly aware of the moment when a morsel would be ready, exhibiting a more than ordinary excitement when they saw the skin drawn back over the head, and knew that the whole carcase would soon be cut off for them. One of these birds was of a desponding, querulous disposition, the other of a very different natural temperament, always contented and cheerful, a universal favourite in the camp, while his fellow received, I fear, many a sly kick for his complaints. They were able to fast for days; but, whenever such an opportunity as a Camel's carcase presented itself, would be revenged on their Lent. I have seen our pet, 'Musha Pasha,' attack the entrails of a Camel, and, as his crop became distended, sink upon his breast, unable to stand, till at length, even this position being too much for him, he lay on his side, still eating, until, overpowered and helpless, he fell asleep. This enormous capacity for food, combined with the power of long abstinence, is a wonderful provision of creative wisdom for carrion-feeders, whose supply is so uncertain, while the necessity for the immediate removal of offensive matter is so urgent. The strength of the Vulture's stomach is equal to its capacity, for on one occasion one of our Griffons devoured a half pound pot of arsenical soap, with no further inconvenience than a violent fit of vomiting."

The Griffon nests on rocks, sometimes several building in company in the same neighbourhood. Its flight is majestic, and Mr. Salvin says that it is a fine sight to watch the ease with which the Griffon sails through the air; the apparently effortless extension of the wing seems amply sufficient to sustain its huge body; no flapping motion is necessary to enable it to mount to a great height. It is only on leaving a rock that a few strokes are requisite to attain the necessary impulse, after which, with primaries bent upwards by the force of the air, it performs its stately evolutions by soaring only. In alighting, the bird drops its legs some distance from the rock, and, sailing to within a few yards, it checks its velocity by two or three heavy strokes of the wing.

Among the ancient Egyptians the Griffon appears to have been a sacred bird, and its remains have been found embalmed. It is also figured on their monuments, sometimes in its natural form, sometimes with the head of a Snake. In size the European Griffon stands about three feet and a half high, and is of a general ashy fulvous colour, with black quills and tail; the under surface is creamy-brown, with a darker brown mark on the crop; the head and neck are bare, or with loosely scattered tufts of white down; and round the neck there is a white ruff.

Besides the Griffon Vulture of Europe there are four others, which seem to be distinct species, the Himalayan Griffon, the South African Griffon, Rüppell's Griffon from Abyssinia, and the Long-billed Griffon from India. In addition to these there are the two White-backed Griffon Vultures, which have only fourteen tail-feathers, and belong to the genus *Pseudogyps*.

THE EARED VULTURE (*Otogyps* + *auricularis* ‡).

This is one of the largest species of the birds of prey found in the Old World, being exceeded in size only by the Great Condor of the Andes. It is an inhabitant of Africa, being plentifully spread over the southern portion of the Continent, and also occurring in North-Eastern Africa, whence it ranges in small numbers to Lower Nubia and the Sahara, and has even been said to occur accidentally in Europe. It has received the name of Eared Vulture on account of the folds of skin on the sides of the neck, which are found only in one other species, the Indian Vulture (*O. calvus*). These two kinds of Eared Vultures appear to play the part of the King Vulture of South America,

* J. H. Gurney: "Descriptive Catalogue of the Raptorial Birds in the Norfolk and Norwich Museum."

† οὖς, ὠτός, an ear; γύψ, a vulture. ‡ *Auricularis*, having ears.

the smaller Vultures, such as the *Neophrons*, always giving place to them, and allowing them to finish their feast before venturing to approach.

The Egyptian Vulture (*Neophron* percnopterus*†) is also familiarly known as Pharaoh's Chicken. It is a small bird about two feet and a half in length, white in plumage, with black wings. A great part of the face is bare and of a yellow colour. The young birds are brown. In Europe the Egyptian Vulture is a migratory bird, but it breeds in many localities in the Mediterranean region, and has even occurred once or twice on the shores of the British islands. In winter it takes itself to the Cape

EGYPTIAN VULTURE.

of Good Hope. It is much valued in certain places as a scavenger, as it devours excrementary matter, but Mr. Gurney states that its food also consists of carrion of various descriptions, and in default of such food it occasionally preys upon rats, field mice, small lizards, snakes, insects, and even earthworms. Colonel Irby observes that it is probably the foulest-feeding bird that lives, and that it is very omnivorous, devouring any animal substance, even all sorts of excrement; nothing comes amiss to it, and he has sometimes seen them feeding on the sea-shore on dead fish thrown up by the tide. The same gentleman‡ says that on their migrations they pass Gibraltar, which is one of their lines of passage, about the end of February, and they breed in the neighbourhood of that place, beginning to lay about the 1st of April. The nest is composed of a few dead sticks, always lined with wool, rags,

* A mythological name.

† περκνος, dark coloured; πτερόν, a wing; so called from the colour of its wings.

‡ "Ornithology of the Strait of Gibraltar," p. 31.

or rubbish; and Colonel Irby states that he found about a pound of tow in one nest, and the sleeve of an old coat; while another observer says that on a foundation of branches Pharaoh's Hen heaps rags, patches, old slippers, and whole basketfuls of camels' hair and wool for the comfort of its offspring. The Egyptians frequently represented this species on their monuments, but do not appear to have attached any particular significance to it.

CONDOR.

In India the place of the present species is taken by the Indian Scavenger Vulture (*Neophron ginginianus*), and in Africa the Pileated Vulture (*N. pileatus*), an entirely brown bird, occurs nearly all over the continent.

THE SECOND SUB-FAMILY OF THE VULTURIDÆ.—THE AMERICAN VULTURES (*Sarcorhamphinæ*).

THE CONDOR (*Sarcorhamphus* gryphus*†).

As before mentioned, all the American Vultures can be readily distinguished by the perforation of their nostrils. The Condor is a very unmistakable species, being the largest of all the Vultures, and the male has a large comb on the head which is not developed in the female. The hind toe also is

* σάρξ, flesh; ῥάμφος, a bill; so called on account of the fleshy wattles on the base of the bill.
† *Gryphus*, a mythological name, a Griffon.

extremely small, scarcely touching the earth, and on this account the foot is less prehensile than in any other Vulture. The home of this magnificent bird is the chain of the Andes in South America, and the neighbouring countries to the west, and it is found inhabiting these mountains from Ecuador and Colombia, down to the Strait of Magellan, and again extending on the east coast as far as the mouth of the Rio Negro in Patagonia. It bears confinement well, examples being generally to be seen living in the Zoological Gardens; and some idea of the extent of wing in the Condor can occasionally be obtained when the birds are sunning themselves on their perch. The expanse in large individuals is said to reach as much as eight or nine feet. All observers agree that when seen in a wild state the flight of the Condor is truly majestic, and it is capable of ascending to an immense height, at which a man could not breathe on account of the rarefaction of the air, a state of things which does not seem to affect the Condor, who is often lost to sight amidst the clouds. The most exaggerated stories of the strength and prowess of this Vulture were circulated by the old authors, and it was even said to attack full-grown oxen. The careful observations, however, of recent travellers, have dispelled many of the fabulous stories respecting it, and it is now a well ascertained fact that the Condor does not attack full-grown animals of any size, but will devour newly-born and helpless offspring, and several of them will unite to kill the mother should she appear in a weak and sickly condition. The supposed habit, attributed to these birds, of carrying off prey in their feet, is disproved by the weakness of the last-named organs, and their utter incapacity for grasping anything: in fact the feet play a very insignificant part in the bird's economy, the powerful bill being the chief factor in tearing a carcase to pieces. The Condor measures about three feet and a half in length, the closed wing being about twenty-nine inches. The general colour of the bird is black, the secondary quills and most of the wing-coverts being externally grey. Round the neck is a ruff of soft white down. The bare parts of the head and neck are not remarkable for any bright colour, but are blackish with traces of livid flesh colour here and there. That the Condor lays sometimes in confinement is shown by a specimen in the British Museum, which was hatched by a common hen, who sat on the egg for six weeks and two days. The nestlings are usually covered with white down.

THE KING VULTURE (*Cathartes* papa*†).

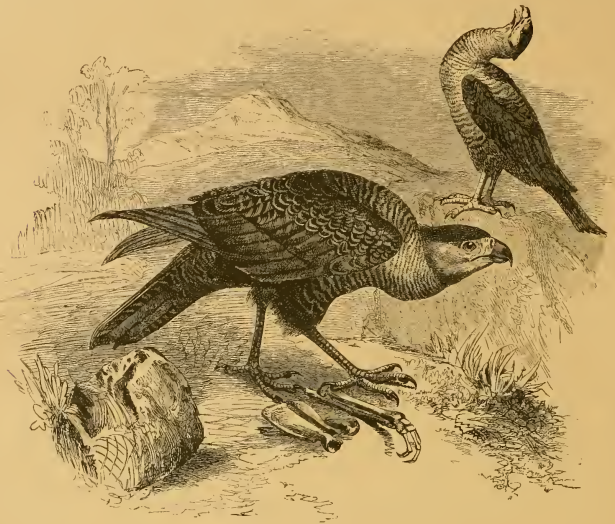
This is by far the handsomest of the whole family, its head and neck being covered with caruncles, which in life are orange, purple, and crimson in colour; the general plumage of the bird, too, is a delicate fawn or cream colour. It is an inhabitant of Central and Southern America, from Mexico southwards to Brazil, where it is found a little below the twentieth degree of south latitude. It appears to be rather a cleaner feeder than the Condor or other American Vultures, and frequents wooded countries instead of those rocky places in which the Condor delights. It is rarer than the last-named bird, and from its forest-loving habits is less easily observed, and it is altogether a more active and lively species. It is shy and suspicious, and is most difficult to obtain, from its habit of sitting on the tops of trees, whence it scans with ease the country around. On this account it is seldom shot, and D'Orbigny, from whose works much of the above information is derived, says that it is only captured by attracting it to a carcase, and then shooting it from an ambush. Another mode of capture, which he says is followed by the natives of Santa Cruz de la Sierra,‡ is by finding out the tree on which the King Vulture roosts, and to which it returns night after night, and then to climb up and capture the bird with gloved hands. The same observer says that it is not from any innate respect, but from fear of its powerful bill, that the Turkey Vultures pay such deference to this present bird, not venturing to commence their repast until he is satisfied, whereby he is popularly known as the "King" of the Vultures.

THE TURKEY VULTURE (*Rhinogryphus*§ *aura*).

This is an inhabitant of North America, whence it ranges throughout Central America and the West Indian Islands down the Andean chain to the Strait of Magellan. Their habits vary somewhat

* καθαρτής, a scavenger. † Papa, a pope. ‡ D'Orbigny, "Voyage dans l'Amérique Meridionale," p. 30.
§ ῥίν (ῥίνος), ῥινός, a nose; *gryphus*, as before, a Griffon, or Vulture; so called on account of its peculiar perforated nose.

with locality, for whereas in the Southern United States they act as scavengers in the towns, in Guatemala and other places in Central America they are not seen in flocks, but occur in pairs only in the forests. As in the case of the other Vultures, their food consists of carrion, and they are found in large numbers in deserts, where they obtain an ample supply of food in the animals which perish. The Turkey Vulture is about two feet and a half in length. The plumage is black with a purplish gloss, and in life the bare head and neck are of a bright red colour, which soon fades after death.



BRAZILIAN CARACARA.

FAMILY FALCONIDÆ.—THE FALCON-LIKE HAWKS.

THE FIRST SUB-FAMILY.—THE CARACARAS (*Polyborinæ*).

All the members of this sub-family are more or less Vulturine in their habits and appearance, and many of them are carrion feeders. The name "Caracara" with which these birds are here designated is of Brazilian origin, and all the species included under the present heading are inhabitants of Central and Southern America, with the exception of the Secretary Bird of Africa. They all seem to be at home on the ground, and they differ from all other birds of prey in having a membrane which joins the base of the two outer toes to the middle one, a feature which is doubtless useful to the birds when wallowing in the marshy ground, which many of them frequent in quest of frogs, &c. The Southern Caracaras (*Ibycter australis*) are said to run with extreme quickness, putting out one leg before the other, and stretching forward their bodies very much like Pheasants. Mr. Darwin, who became acquainted with these birds during his voyage in the *Beagle*, says that their flesh is good to eat, and he gives a very interesting

account of the habits of the Southern Caracara in the Falkland Islands, where they were extraordinarily tame and very mischievous, frequenting the neighbourhood of the houses to pick up all kinds of offal. If a beast were killed they congregated from all quarters like so many Vultures, and they did not hesitate to attack and capture wounded birds, on one occasion pouncing on a Dog which was lying asleep. They would also carry off miscellaneous articles which were lying on the ground. "A large black glazed hat was carried nearly a mile, as were a pair of heavy balls, used in catching wild cattle. Mr. Usborne experienced during the survey a severe loss in a small Kater's compass, in a red morocco case, which was never recovered." According also to Mr. Darwin, these birds were quarrelsome and extremely passionate, and it was curious to behold them, when impatient, tearing up the grass with their bills, from rage. It may be owing to their strong feelings, as described by the last-named naturalist, that the colour of the face changes in the Brazilian Caracara, concerning which a somewhat amusing incident may be related. There arrived from Patagonia at the Zoological Gardens two Caracaras, which were white instead of brown, like the Brazilian species (*Polyborus thurus*), and the question which troubled naturalists was, whether these Patagonian birds were a distinct species, or whether they were simply a white variety of the ordinary Brazilian bird. The latter had the bare skin of the face lemon-yellow, whereas the white birds had this part purple, and this was looked upon as one sign of their belonging to a distinct species. But one memorable day an ornithologist went up to describe the new arrivals, and to bestow on them a name, which should mark the character of the purple face. No doubt existed in his mind, for the white birds had now lived for a whole year in the Gardens, and were still white and had a purple visage, but, happening to turn his head away for one moment, he was not a little surprised, on looking back at his supposed new species, to find that the facial character had disappeared, and that the bird's visage was now yellow. At the same moment the face of one of the Brazilian birds in the adjoining den had turned red, and hence it became clear that the Caracaras can change the colour of the bare face at will, and that the lighter-coloured specimen was only an albino after all! Besides the Caracaras, at least one other species of bird of prey changes colour in a somewhat similar way—the Bateleur Eagle,* which, if irritated, flushes up to the roots of its feathers, and its bare face, which is usually scarlet, becomes a deep blood-red or crimson. In the case of the latter bird the change of colour is visible not only in the visage but in the feet also, which likewise acquire a darker red than before.

THE SECRETARY BIRD (*Serpentarius*† *secretarius*‡).

This is the only African representative of the Caracaras, or web-footed birds of prey, and from its general look and from its habits, no less than from some peculiar anatomical characters, it is by many good authorities considered to be a game bird, and not a Hawk at all. No one, however, who has seen a Secretary kill a Rat, and the prodigious force with which, by repeated blows of his powerful legs, sometimes springing into the air and bringing both feet down at the same moment upon his victim, he quickly reduces it to a shapeless pulp, would consider him anything but a bird of prey. Standing before a Cobra which rises to attack him, the Secretary spreads his wings out in front as a shield to guard his body, and then from behind this protection he strikes his enemy down. On account of their prowess in destroying venomous Serpents, they are protected with care by both the European and Native Governments in South Africa, and in the Cape Colony a penalty is inflicted upon any one who ventures to kill one of these useful birds. Sometimes the Secretary does not win in the fight with the Snake, for a good observer has stated that on one occasion he saw a bird suddenly leave off fighting and run to a pool of water, where he fell down dead. If the Snake bites a feather, the bird immediately pulls it out, but in the above instance the reptile had drawn blood from the point of the pinion. It is somewhat remarkable that the Secretary should have such striking power in his legs, as they are long and slender for the size of the bird, and are so brittle that it is said that, if suddenly started into a quick run, their legs will snap. The Secretary Bird is a most voracious feeder, devouring Rats, Lizards, Locusts, Snakes, Tortoises, &c., and Levaillant states that he took from the stomach of one of these birds three Serpents as long as his arm

* *Helotarsus ecaudatus.* † *Serpentarius*, a devourer of Serpents. ‡ *Secretarius*, a secretary.

and an inch in thickness, eleven Lizards of seven or eight inches in length, and twenty-one small Tortoises of about two inches in diameter, besides a large quantity of Grasshoppers or Locusts, and other insects.

A spirited and truthful account of the habits of the Secretary was published in 1856 by the late M. Jules Verreaux, who spent upwards of fifteen years in South Africa engaged in a study of the natural history of that part of the world, and a few extracts from this paper cannot be resisted.*

SECRETARY BIRD.

"As Nature exhibits foresight in all that she does, she has given to each animal its means of preservation. Thus the Secretary Bird has been modelled on a plan appropriate to its mode of life; and it is therefore for this purpose that, owing to the length of its legs and tarsi, its piercing eye is able to discover at a long distance the prey which, in anticipation of its appearance, is stretched on the sand or amongst the thick grass. The elegant and majestic form of the bird becomes now even more graceful; it now brings into action all its cunning in order to surprise the Snake which it is going to attack; therefore it approaches with the greatest caution. The elevation of the feathers of the neck and back of the head shows when the moment for attack has arrived. It throws itself with such force on the reptile that very often the latter does not survive the first blow. But if the bird does not succeed,

* *Proceedings of the Zoological Society*, 1856, p. 348.

and the enraged Snake draws itself up and expands, at the same time, the skin of its neck, as is the way with the more dangerous Serpents, the bird is forced to retreat, and takes a spring backwards, waiting to seize a favourable moment for recommencing the attack. Raising itself, the furious reptile moves its tongue with the quickness of lightning, and gives forth the most vehement hisses, which keep back the enemy and seem to force some respect from it: but the bird, whose courage redoubles in the same ratio that the difficulties increase, opens out its wings, and, returning to the charge, assails the reptile afresh with blows from its terrible feet, such as no one would believe, and which are not long in putting the Snake *hors de combat*. We have, however, sometimes seen the Snakes launch themselves on the Secretary, but, either by opening its wings, whose long primaries serve it as a kind of shield, or by jumping backwards or on one side, the bird is certain to parry the attack of its antagonist, who at last, overcome by fatigue, falls at full length on the ground. The moment is seized by the Secretary to redouble its massive blows, which, by dislocating the vertebral column, soon cause the reptile to give up the ghost. It is then that the victorious Hawk darts like an arrow, and placing its foot on the Serpent's neck, just at the back of the head, commences to swallow it, which it does by beginning at the tail first. Nor is this a long operation, even with reptiles five or six feet in length and more than four inches in diameter; and as soon as it arrives at the head it completely smashes the skull by several blows of its bill before swallowing it."

"Both sexes work at the construction of the nest, which is always placed on the summit of a high dense bush, more often a mimosa. It is added to each year, and it is easy to see the age of a nest by the number of fresh layers which have been added year by year. The young birds remain for six months before leaving the nest, their legs not being strong enough to support the weight of the body. During the whole of this time they are fed with great assiduity by both parents."

The Secretary Bird stands more than four feet high, when fully grown. The general colour of the plumage is grey, with black quills; the lower back and rump are black, the upper tail-coverts white; the tail is grey, tipped with white, and crossed with two black bands; below, the colour is ashy-white, the thighs and abdomen black. From the hinder part of the crown and occiput springs an elegant crest of plumes, which the bird can raise or depress at will; they are either entirely black, or grey with a black tip. It is from these long plumes that the bird has got the name of the Secretary, from some fancied resemblance in the bird's head to the quills which a secretary places behind his ear.

In America, the Secretary is represented by the Çariama (*Çariama cristata*), a bird which looks so like a game bird that, as we have said, many ornithologists place both it and the Secretary among the Gallinaceous birds, and not among the Hawks. From a consideration of its anatomy, however, both Professor Parker and Professor Sundevall determined that the Çariama is an accipitrine bird, though of a very aberrant form. Those who differ from them admit that where the Secretary is placed in the natural system the Çariama must also be located, and no one who has studied the habits of the former, either in a wild state or in captivity, can doubt for a moment that it is a veritable bird of prey, and so it follows that the Bustard-like Çariama must also be included in the same order.

CHAPTER IV.

THE LONG-LEGGED HAWKS AND BUZZARDS.

THE BANDED GYMNOGENE—Habits—Its Movable Tarsi—THE HARRIERS.—Distinctive Features—THE MARSH HARRIER—Habits—Its Thievish Propensities—THE HARRIER-HAWKS—Colonel Greyson's Account of their Habits—THE CHANTING GOSHAWKS—Why so Called—Habits—THE TRUE GOSHAWKS—Distinctive Characters—THE GOSHAWK—Distribution—In Pursuit of its Prey—Appearance—THE SPARROW HAWKS—Distinctive Characters—THE COMMON SPARROW-HAWK—Habits—Appearance—THE BUZZARDS—Their Tarsus—THE COMMON BUZZARD—Where Found—How it might be turned to Account—Food—Its Migrations—Habits—Appearance—THE HARPY.

THE SECOND SUB-FAMILY OF THE FALCONIDÆ.—THE LONG-LEGGED HAWKS (*Accipitrinæ*).

ALL the Hawks included under this heading are remarkable for their long legs, in which the tibial bone and the tarsus are about equal in length. In all the other Hawks, Eagles, Kites, Buzzards, and Falcons, the tibia is always longer than the tarsus.

The Long-legged Hawks are not such powerful birds of prey as the Eagles or Falcons, and do not possess, as a rule, the same dash and courage in pursuing their quarry, many of them feeding on a low kind of diet, and being robbers of eggs and destroyers of young birds. The birds of prey belonging to this sub-family are—1. The Gymnogenes; 2. The Harriers; 3. The Goshawks; 4. The Sparrow-Hawks.

THE BANDED GYMNOGENE* (*Polyboroides*† *typicus*).

From its general appearance, especially in its naked yellow face, this remarkable Hawk is considered to be a close ally of the Secretary Bird; but the proportions of its legs and its habits proclaim it to be nearly related to the Harriers. Two kinds of Gymnogenes are known, one inhabiting Africa, and the other being found in Madagascar. The food of the present species appears to consist of Frogs and Lizards, and at times it walks over the ground which has been recently burnt, in pursuit of insects and small reptiles; at other times it will sit for a long time on stumps by pools of water, watching for Frogs, which in such situations form its favourite food. The Gymnogenes are remarkable in the class of birds for being able to put their leg "out of joint" at will (that is to say, they can bend the tarsus backwards just as they please); and this is a fact which may be accepted as a certainty, since its truth has been tested by many trusty and independent observers. One of these, the late M. Jules Verreaux, states that the tarsi are movable at the "knee"-joint toward the front from behind, a provision which, from the facility it affords the bird for drawing up Frogs out of the marsh-holes by means of its talons, is of no little service to it. The exceedingly compressed toes of this species also enable it to introduce its long tarsi into the narrow crevices of the rocks. He saw it twist and turn its legs in all directions in capturing its prey in marshy places. Mr. Thomas Ayres also says that "the legs of this bird bend backward at the knee in an extraordinary manner, very much as if they were out of joint."

The Banded Gymnogene is nearly twenty-four inches in length, and is of a light grey colour, with black wings, the secondaries being grey like the back, with a black band before the tip; the lower back is white barred with black; the tail black with a white tip and a white bar across the middle; the throat and chest are grey like the back, and the rest of the under surface is white barred with black. The cere and bare space round the eye are yellow when the bird is alive.

THE HARRIERS (*Circus*).

All the Harriers have a facial disc as in the Owls, though not so distinct as in the latter group of birds. In both, however, the disc is formed by a ruff of soft, close-set plumes, which encircle the face; and hence in most classifications the Harriers have been considered as being closely allied to the Owls, on account of their having this "facial disc." Their structure and habits, however, entirely do away with the idea of there being any real affinity between these two groups of accipitrine birds.

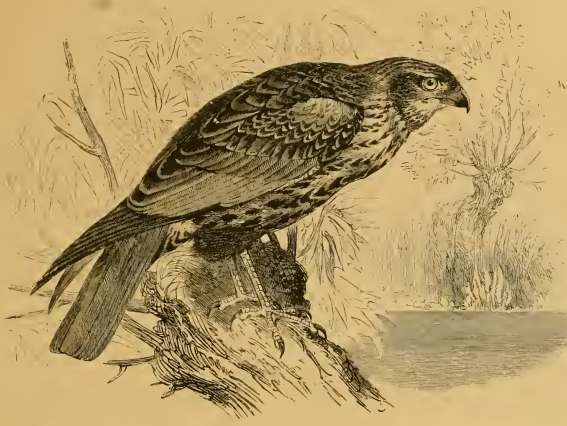
Before the draining of the fens in England, Harriers were by no means uncommon in certain localities; but they are becoming rarer year by year, as each favourite haunt passes from them under the dominion of the agriculturist. Three kinds were found in England, of which the Hen Harrier (*Circus cyaneus*) was the rarest; Montagu's Harrier (*C. pygargus*) was the most plentiful and the most widely distributed; and the Marsh Harrier, or Moor Buzzard (*C. æruginosus*), the most powerful. This is the species which has held its own best, as it is still found breeding in some few places in the United Kingdom. The habits of all the Harriers are very similar, and the genus Circus is probably with the exception of the Peregrine Falcons—the most universally distributed of any Raptorial birds, for there is scarcely any part of the world where a Harrier is not found.

THE MARSH HARRIER (*Circus æruginosus*).

This is an inhabitant of the Old World, where it enjoys a wide range. It is one of the greatest robbers of eggs and young birds, being, in countries where it is still plentiful, a great nuisance to the sportsman, as, says Colonel Irby, "slowly hunting along in front, it puts up every Snipe and Duck

* Gymnogene: from two Greek words (γυμνός, bare, naked; γένυς, a cheek). † *Polyboroides*: like a *Polyborus* or Caracara.

that lies in its course, making them unsettled and wild."* The same authority furnishes the following interesting particulars about the habits of the present species:—"In Andalusia, as well as in Morocco, over all low wet ground, the Marsh Harrier is to be seen in vast numbers, particularly in winter. Great quantities remain to breed, sometimes as many as twenty nests being within three hundred yards of one another. The latter, loosely constructed with dead sedges, vary very much in size and depth, and are usually placed amidst rushes in swamps, but sometimes on the ground among brambles and low brushwood, always near water, though occasionally far from marshes. They begin to lay about the end of March, and at that time fly up a great height, playing about, and continually uttering their wailing cry. The eggs are bluish-white, and usually four or five in number; they certainly vary in size and shape, and are often much stained. Like the eggs of all the Harriers that I am acquainted with, and many others of the Accipitres, when blown and held up to the light they show a bluish



MARSH HARRIER.

tinge. I once found a nest containing only one egg nearly ready to hatch, and saw another with six eggs (three quite fresh, and the other three hard sat on). I believe that if the first set of eggs be taken they lay again in a fresh nest, as I found sets of fresh eggs as late as the 2nd of May.

"Cowardly and ignoble, they are the terror of all the poultry which are in their districts, continually carrying off chickens, and, like other Harriers, are most terribly destructive to the eggs and young of all birds. On account of these propensities, I never let off a Marsh Harrier unless it spoiled sport to fire at one. Sometimes, when at Casa Vieja, and the Snipe were scarce, we used to lie up in the line of the Harriers' flight to their roosting-places; for they always take the same course, and come evening after evening within five minutes of the same time. Upon one occasion a friend and myself killed eleven, and during the visit accounted for over twenty. I also upon every possible opportunity destroyed the nest and shot the old ones; but it was the labour of Sisyphus, for others immediately appeared. However, there was a visible diminution of their numbers at Casa Vieja. I never saw rats in their nests or crops, and believe they have not the courage to kill them; small snakes, frogs, wounded birds, eggs, and nestlings unable to fly, form the main part of their prey. I have seen the

* Col. Irby, "Ornithology of the Strait of Gibraltar," p. 34.

Marsh Harrier hawking over the sea about two hundred yards from the shore, where there was shallow water, but could not see what they were taking."

THE HARRIER-HAWKS (*Micrastur* *).

These constitute a little genus of Hawks peculiar to the New World, where they form a perfect link between the Harriers and the Goshawks. In form they are stoutly-built birds like the latter, while they retain the facial ruff of the Harriers, and hence the name of Harrier-Hawk adopted for them here. Their habits are well described by a good observer, the late Colonel Greyson, of the U.S. Army, who writes of the largest species of the genus, the Harrier-Hawk (*Micrastur semitorquatus*) :—

"Among the great variety of Hawks to be met with in a single day's excursion in the locality of Mazatlan, none are so easily recognised as this peculiar and interesting species. I have found it only in the heavy forests, or the immediate vicinity of a thickly-wooded country, where its slender form and lengthened tail attract our attention as it swiftly glides through the tangled woods with that remarkable ease which we have often noticed in the Sharp-shinned Hawk (*A. fuscus*). It appears to be strictly arboreal in its habits, and possessed of wonderful activity, either in springing from branch to branch without opening its wings, or rapidly darting through the intricacies of the bush with apparently but little difficulty. I have seldom seen one of these Hawks in an open country, and have never seen one flying higher than the tree tops, where they are met with. Its wings are rather short, and its flight is performed by rapidly repeated strokes, only for a short distance at a time. It preys upon various species of wood birds, which it captures by darting upon them on the ground or in the bushes; but the Chachalaca is its favourite game. This is a gallinaceous bird, or wild chicken, about the size of, or lighter than, the common hen, and is entirely arboreal, seldom running upon the ground, but is able by its peculiarly-formed feet to cling to, or spring rapidly through, the thickest branches with great agility; but this Hawk follows it with equal facility, until an opportunity offers to strike its prey, then both come to the ground together, the Hawk being the lighter bird. I witnessed a scene of this kind that took place when I was endeavouring to get a shot at a Chachalaca, as it was jumping about the very thick branches of an acacia overgrown with lianas; it appeared to be in great distress, uttering its harsh notes of alarm, and spreading its fan-shaped tail. Suddenly I saw one of these Hawks pounce upon it; when with harsh screams of terror and pain the Chachalaca dragged its captor to the ground, where they struggled for a few moments, but the unfortunate bird was soon overcome. The struggling and screams of the Chachalaca created a great commotion among the denizens of the woods; far and near were heard the harsh cries of other members of its family, and the Urraca Magpie, with streaming tail and ludicrous gesticulations, as well as the Blue-back Jay, and other birds in the neighbourhood, gathered around to witness the scene of rapine. Suddenly appeared in the midst of this clamour a larger Hawk (*Buteo Harrisi*, Aud.), which rushed at once upon the captor of the Chachalaca. Unable to withstand so heavy a charge, he was compelled to give up his honestly captured prey to a superior force, thus proving the old adage that 'might is right.' The slender but compact figure of our present subject was now seen perched upon a neighbouring bough, scrutinising, with a vicious eye, the more powerful but less active bird of prey, as he vainly attempted to bear off the lifeless form of the Chachalaca; but there was one yet mightier than he. I observed it for a few moments, then shot it, as also the Long-tailed Hawk, thus securing all three.

"They build their nest of dry twigs and moss, which is placed in a very tall tree, but below the higher branches. The only nest I have seen was inaccessible, therefore I regret that I am unable to describe the eggs."

THE CHANTING GOSHAWKS (*Melierax* †).

These birds are met with in Africa only, and they have received the name of "Chanting" Goshawks from their song, which has been stated by the French traveller, Levaillant, to be of considerable power, for he says he has heard the male of the Cape species (*Melierax canorus*) sing for hours together in the twilight of morning and evening, and sometimes through the night. This, however, has been

* μικρός, small; *astur*, a Goshawk. See "Lawrence's Birds of Western and North-Western Mexico." "Memoirs of the Boston Soc. of Nat. Hist," Vol. ii., p. 299.

† μέλι, honey; ἱέραξ, a Hawk.

questioned by Mr. Layard, who is well known as an authority on African birds, and who observed the species in some abundance in certain parts of South Africa. According to this observer, the bird will perch on the top of a high tree, utter its "mellow piping whistle," and fly off again. He has also heard it call when flying. Now, although the Chanting Goshawks may not have such powers of song as have been credited to them, it is certain that they really have a more varied note than is the case with other Goshawks, and the Red-faced Goshawk (*Melierax gobar*) is said to whistle very much and better than *M. canorus*. About five different species of Chanting Goshawks are known, all being from Africa: hence the genus *Melierax* is one of those forms characteristic of the *Ethiopian region*, which embraces Africa below the Sahara desert. One species only, the Many-banded Goshawk (*Melierax polyzonus*), a frequent bird in Abyssinia and Senegambia, is known to wander beyond the limits of the above-named region, as it occurs in Mogador, whence living specimens have been more than once sent to the Zoological Gardens.

The habits of the Chanting Goshawks are very similar to those of the ordinary Goshawks of more northern climates, the larger species feeding on Quails, Francolins, and other small game, reptiles, and locusts, while the less powerful kinds devour small birds and reptiles. The colour of the plumage is a pearly-grey in the South African Chanting Goshawk (*M. canorus*), the belly being white with greyish cross-lines; the rump is white; the primary quills black; tail dusky, tipped with white and crossed by broad white bars; the cere and legs are red; the iris dark brown. It measures about three feet in length. This style of colouring is found in all the species, excepting one small one, which is entirely black all over, save some white spots on the tail, and is known as the Black Goshawk (*Melierax niger*).

THE TRUE GOSHAWKS (*Astur*).

These are represented nearly all over the world, every country having one or more species of the genus Astur, excepting the continent of South America, which possesses only two kinds, both of them rare and of limited range. More than thirty different species of the genus have been described, and they present great differences in size and style of coloration, their habits varying equally, according to the strength and power of the birds; but they are all remarkable for a very sturdy bill, and thick-set legs and sharp talons. A Goshawk may always be told by the latter characters, and by its short toes, which are perhaps smaller in proportion to the size of the bird than in any other group of the birds of prey.

These birds, and the Sparrow-Hawks, have very short wings, and have not the same power of flight as in the true Falcons, which are long-winged birds; and hence, in the old days of falconry, they were never considered of such value as the Peregrine in the chase. They were also called Hawks of the "fist," as they were flown at game from the hand, instead of soaring down on the quarry from aloft.

THE GOSHAWK (*Astur palumbarius*).

This is the largest and most powerful of all the genus, as it is also the best known, being found all over the northern parts of Europe and Asia. It used to be of more frequent occurrence in Britain formerly than it is now; and although it can only nest in this country on the rarest occasions in the present day, the author was introduced to an old gamekeeper on the Marquis of Huntly's estate at Aboyne, who perfectly remembered the Goshawk breeding regularly at Glentanner. A young bird is still captured now and then in autumn, one of the last instances being that of a young male, who was captured in an area at Hampstead, on the 3rd of August, 1872, and is now in the British Museum.

It will feed on nearly every kind of bird and animal that it is able to catch, and in falconry it is principally employed to take Hares and Rabbits; it will also take Pheasants and Partridges, a great number of these latter birds being killed by the Goshawk in its wild state. It is able to pursue its quarry with great dexterity through a wooded country, and it possesses great powers of abstinence, so that, if its prey escapes into cover for the time, the Hawk will often wait for its re-appearance, and will generally exhaust the patience of the quarry, and succeed in capturing it. During the day-time it remains solitary in dark fir-forests, and comes out to feed in the morning and evening. The nest is often a huge structure, being added to year by year; and an immense nest is figured in

Professor Newton's "Ootheca Wolleyana." Some idea of the size may be gained from the story told by Mr. Wolley, who climbed up to one that was placed a good height up in a large Scottish fir, and when he stood on the same branch with the nest, the latter still reached several inches above his head, so that the building of this nest had probably been the work of several years.

GOSHAWK.

The old birds are alike in plumage; but the female, as is the case with all Goshawks, is larger than the male, measuring about two feet in length, while the male does not exceed twenty inches; the wing also, which is about twelve inches in the male, exceeds fourteen in the female. The colour is grey, the head black, the sides of the face white, streaked with black lines; below, the under surface of the body is white, barred across with black cross-bars of ashy-brown; the under tail-coverts are white; quills and tail ashy-brown, the tail feathers tipped with white; cere yellow; bill bluish; iris orange. The young birds differ considerably from the adults, being rufous below, with longitudinal streaks of dark brown; the upper surface is brown, all the feathers being margined with reddish-white.

In North America, a bird very similar to the Goshawk takes its place; and a third species of the same group is found in Madagascar only. It is, however, principally in the Malayan Archipelago that the greatest number of species occur, nearly every island possessing a Goshawk peculiar to itself.

THE SPARROW-HAWKS (*Accipiter*).

These may almost be called miniature Goshawks, as they are not only short-winged birds like the latter, but they even have the same style of plumage, consisting generally of a dark-grey back, a barred under surface, and a piercing yellow eye. They may, however, be distinguished from the Goshawks by their small, weak bill, and long, slender, middle toe. With the exception of some of the Oceanic Islands, Sparrow-Hawks are found all over the world, being plentiful even in South America, where the rarity of the Goshawks has already been alluded to.

THE COMMON SPARROW-HAWK (*Accipiter nisus*).

This is an active and plucky little bird, which still holds its own in England, notwithstanding the raids made upon its nest, and the destruction of old birds by keepers. Nor can it be denied that the Sparrow-Hawk, hatching its young about the time when the young chickens and Pheasants are also being reared, will occasionally make a swoop on the pheasantry, and carry off the chicks to feed its own offspring. The principal food of this Hawk is small birds, in the pursuit of which it is so eager

that it has several times been known to dash through a glass window, and be caught in the room; while Messrs. Salvin and Brodrick, in their work on British Falconry, state that they have "known a trained Sparrow-Hawk force itself to such an extent into a blackthorn bush, where it had killed a bird, as to require to be cut out." Like the Goshawk, it is often trained for hawking, but is a much more delicate bird to rear, and requires careful management when young. Nevertheless, a well-trained Sparrow-Hawk will account for a considerable number of birds; and in the work of the above-mentioned authors is given an instance of one Hawk having killed 327 head in less than two months, consisting of Sparrows, Blackbirds, Thrushes, a few Partridges, and Linnets, more than two-thirds of the number being Sparrows.

SPARROW-HAWK. (*After Keulemans.*)

In size the female Sparrow-Hawk is considerably larger than the male, measuring nearly sixteen inches in length, and nine inches and a half in the wing. She is generally paler grey, never so blue as in the male, nor is she so red underneath. A sign of age, by which a mature hen Sparrow-Hawk may be known, is the presence of a tuft of rufous plumes on the flanks, which is feebly developed in the young bird, but is a conspicuous feature in the adult.

The male is bluish slate-colour above, the quills browner and barred across with darker brown, these bars being very distinct below; the tail is barred with blackish-brown, and tipped with white; cheeks and ear-coverts are rufous; under surface of body whitish, with narrow bars of bright rufous, the under tail-coverts white, as are also the under wing-coverts and axillaries, these two latter parts being spotted with brown. Young birds are brown with rufous edges to the feathers; underneath they are rufous, barred with brown on the flanks and breast, the throat and fore-neck streaked with the same colour. The bars on the tail are five in number in a young male, but as the bird increases in age the number of bars decreases, and is generally only four in a very old bird: the same takes place in the female. The range of the Common Sparrow-Hawk is very similar to that of the Goshawk, being extended all over Europe and Northern Asia, and into Northern China and North-western India. Neither of the birds go to South Africa, and range into the north-eastern portion of that continent only in winter.

THE THIRD SUB-FAMILY.—THE BUZZARDS (*Buteoninæ*).

These Hawks constitute a numerous assemblage of the birds of prey, and lead on from the long-legged Hawks of the previous sub-family to the Eagles, ending with the Great Harpy, which is, perhaps, the most powerful bird of prey in the world. All the Buzzards have the tibia much longer than the tarsus, but they may be distinguished from all the Eagles, Kites, and Falcons by having the back of the tarsus "plated," and not "reticulated." In the accompanying woodcuts is shown the hinder aspect of a Buzzard's tarsus (figure on p. 274), by which it will be seen that the scales are arranged in plates, very differently from that which takes place in the tarsus of an Eagle (figure on p. 274), where the scales are reticulated.*

The Buzzards are more numerous in the northern parts of the world than in the tropics, and a large decrease in the number of species takes place in Central and Southern America, whilst in Oceania and Australia they are altogether absent. As a rule, they are birds of plain plumage and

* *Rete*, Lat., a net, so called on account of the network pattern.

sluggish habits, possessing neither the courage of the Eagles, nor the dash and adroitness of the Falcons, in capturing their prey. Africa produces some species which, as regards plumage, are an exception to the general rule, the Augur and Jackal Buzzards (*Buteo augur* and *Buteo jackal*) being rather handsome birds, their plumage being a mixture of black and chestnut.

HIND VIEW OF TARSUS OF BUZZARD, SHOWING THE PLATED ARRANGEMENT OF SCALES (A).

THE COMMON BUZZARD (*Buteo* vulgaris*).

This is a strictly European bird, although it has been stated to occur in Central Asia, and to sometimes wander into North-eastern Africa. Like all other birds of prey, it is rather rare in Great Britain, but it still breeds in certain localities, although the great majority of specimens which are killed in Britain are found in the fall of the year. The power of the Common Buzzards to attack large game is very limited, and Mr. Robert Gray† observes :—"To many persons it will seem unwise, I dare say, to call this Buzzard a useful bird in game preserves, yet I cannot but think that if the experiment were made of allowing it to fulfil the ends for which Nature designed it, our native game birds would benefit by the trial. So far as my own observations have extended, the Common Buzzard is just the kind of instrument wanted to clear off sickly young birds, which, on arriving at maturity, yield an offspring of a degenerate breed. Of somewhat sluggish habits, it does not care to interfere with strong-winged birds, being content with those that, through wounds or a naturally feeble constitution, are unable to save themselves. In this way only strong birds are left, and a healthy breed ensues. Let any of our proprietors of moors, who are jealous of the daring prowess of Eagles and lordly Peregrines, act upon this hint, and I will venture to say we should have fewer instances of disease amongst game birds to chronicle."

Although the Buzzard does not quarter the ground like a Harrier, and search for its prey on the wing, it may not unfrequently be seen circling in the air at a considerable height, generally over the place which contains its nest, but as a rule it perches on some stone or similar resting-place, whence it watches for its prey. When flying it utters a clear loud cry, which has been described as "mewing." Its principal food consists of Field Mice, but it also devours Moles, young birds, the caterpillars of Hawk Moths (*Sphingidæ*), Grasshoppers, and it will also occasionally feed on carrion, or on dead fish cast up on the sea-shore. When migrating in the autumn, which it does in considerable numbers together, a good many are caught for the purposes of food, and the manner of catching them is thus described by Nilsson in his work on the birds of Sweden :—"In October, when they pass through Skåne on their passage to the south, they remain for some time on the outermost point of land to await a suitable westerly wind to cross. Large numbers collect and roost at night in the trees (especially in the willows) which grow there. When the darkness sets in, two men go in company to catch them, one with a sack, and the other with a stout cudgel. The latter climbs quietly up into the tree, where he can just distinguish the bird, whilst the other remains below ; and so soon

HIND VIEW OF TARSUS OF SERPENT EAGLE, SHOWING THE RETICULATED ARRANGEMENT OF SCALES.

* *Buteo*, Lat., a Buzzard.

† "Birds of the West of Scotland," p. 46.

as the climber has got up to where he can reach a bird, he catches it by the legs with the left hand, and either twists its neck with his right hand, or stuns it with a blow of the cudgel, and throws it down to his companion on the ground, who crams it into the sack. In this manner two men can catch thirty or forty in the evening, or, according to Burgomaster C., as many even as seventy or eighty ; and Captain E. relates that twenty were obtained one evening from the same tree. They are easiest to catch when it is dark and blowing hard, so that the bird cannot easily hear the noise. In all, many hundreds are caught annually, some of which are cooked fresh or made into soup, but most are salted down and kept for use during the winter."

The nest of the Buzzard is generally placed on some non-evergreen tree at various heights from the ground, but in Scotland it builds on rocks. The usual number of eggs is three or four, and these

COMMON BUZZARD.

are a bluish-white, with reddish blotches. They vary a good deal in colour, some being rather richly marked, while others are almost colourless. The time of breeding is generally the month of April, or, in severe seasons, early in May. A Crow's nest is occasionally taken possession of. When the bird makes its own nest, this is formed of large branches with a lining of grass, occasionally of a few feathers. No bird varies more than the Buzzard in plumage, and many beautiful variations in its dress take place before the adult plumage is gained. The old bird is almost entirely brown above and below, the breast and abdomen generally having a more or less barred appearance ; the quills are brown, banded with darker brown, and shaded with grey on their outer aspect ; the tail is ashy-brown, more or less inclining to rufous, and having twelve or thirteen bars of darker brown. Young birds have a great deal of white about their plumage, some of them being nearly cream-coloured. The size of the adults is about twenty-two inches, and the sexes vary a little in dimensions, the wing of the female being perhaps one inch longer than that of the male.

The great utility of the Buzzard in destroying Mice ought to render it an object of protection and encouragement, for the number of small Mammals destroyed by these birds is immense. Brehm

calculates that when they have young they will destroy at least one hundred Mice a day, and mentions that thirty Field Mice have been taken from the crop of a single bird.

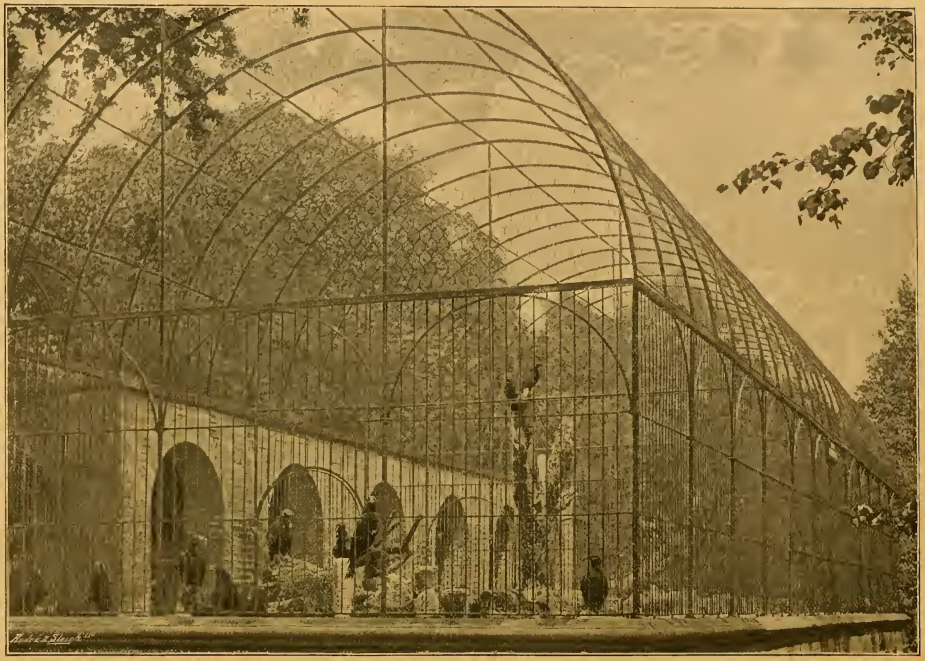
THE HARPY (*Thrasaëtus* harpyia* †).

Although from its size and courage this bird is generally called the *Harpy Eagle*, it is evident from its structure that it is a Buzzard, as it possesses the "plated" tarsi of the latter group of birds.

THE HARPY.

It is an inhabitant of the New World, from Mexico through Central America to Brazil and Bolivia. It is a very destructive bird, causing great damage to the flocks, and even destroying calves, whence it is an object of detestation to the stock-keepers in Mexico. It also feeds on deer and on the large Macaws which are found in the forest it frequents. It stands more than three feet and a half high, and has a large crest, which, together with its powerful talons and glittering eye, gives the bird an imposing aspect even in captivity. In the adult bird the coloration is ashy-grey, inclining in very old examples to silvery grey relieved by the dark ash-coloured wings and tail.

* θράσος, daring ; ἀετός, an Eagle. † ἅρπη a bird of prey.



THE EAGLES' CAGE, ZOOLOGICAL GARDENS, LONDON.

(From a Photograph by Symmons and Co., Chancery Lane, taken expressly for this work.)

CHAPTER V.

EAGLES AND FALCONS.

THE EAGLES—THE BEARDED EAGLE, OR LÄMMERGEIER—A Visit to their Nest—Habits—A Little Girl carried off alive—Habits in Greece—Appearance—Von Tschudi's and Captain Hutton's Descriptions of its Attacks—THE TRUE EAGLES—THE WEDGE-TAILED EAGLE—Eye—Crystalline Lens—How Eagles may be Divided—THE IMPERIAL EAGLE—THE GOLDEN EAGLE—In Great Britain—Macgillivray's Description of its Habits—Appearance—THE KITE EAGLE—Its Peculiar Feet—Its Bird's-nesting Habits—THE COMMON HARRIER EAGLE—THE INDIAN SERPENT EAGLE—THE BATELEUR EAGLE—THE WHITE-TAILED EAGLE—A Sea Eagle—Story of Capture of some Young—THE SWALLOW-TAILED KITE—On the Wing—THE COMMON KITE—THE EUROPEAN HONEY KITE—Habits—ANDERSSON'S PERN—THE FALCONS—The Bill—THE CUCKOO FALCONS—THE FALCONETS—THE PEREGRINE FALCON—Its Wonderful Distribution—Falconry—Names for Male, Female, and Young—Hawks and Herons—THE GREENLAND JER-FALCON THE KESTRELS—THE COMMON KESTREL—Its Habits and Disposition.

THE THIRD SUB-FAMILY OF THE FALCONIDÆ.—THE EAGLES (*Aquilinæ*).

As already explained, the Eagles may be distinguished from the Buzzards by their reticulated tarsus; otherwise the proportions of the leg-bones are similar, the tibia being considerably longer than the tarsus.

THE BEARDED EAGLE, OR LÄMMERGEIER (*Gypaëtus barbatus*).

The generic name of this Eagle is derived from two Greek words (γύψ, a Vulture, ἀετός, an Eagle), and no name could have been better chosen, for with the structure of an Eagle it combines many of the habits of a Vulture, and has many ways in common with the Egyptian Vulture (*Neophron percnopterus*). In Europe it is found only in the mountainous parts of those countries bordering the Mediterranean basin, and is now nearly extinct in Switzerland. In the mountains of Spain, however, it is still to be met with in some quantities, and Mr. Howard Saunders states that one or two pairs may be found in every range of mountains. In Sardinia it is said by Mr. Basil Brooke to be decidedly common, and during one of his visits to that island he obtained a very curious nestling bird covered with down. "A pair of these birds," says Mr. Brooke, "are in possession of every separate range of hills, which they appear to regard as their own territory, and from which they are seldom to be found far distant. They are generally to be seen singly or in pairs; but now and then I have observed three, and on one occasion four together. As a rule they are most decidedly mountain birds, but occasionally a single bird may be seen hunting over the plains and cultivated lands, not flying more than one hundred yards high. The nest of one found on the 18th of April was built on a broad ledge of a precipitous cliff, about three hundred feet high, within twenty feet of the top, and was completely sheltered from the severity of the weather by a large overhanging piece of rock. After some trouble I discovered a way by which, with a little care, I managed to get on the ledge, much to the discomfort of the solitary inmate—a young nestling, covered as yet with a pale yellowish-brown down. The nest itself was an accumulation of dried sticks, with a cup-shaped hollow in the middle, and had evidently been used for years. In it, and on the surrounding ledge, were great quantities of the leg-bones and feet of goats, &c., and a part of a fox's lower jaw; these being in all stages of putrefaction, the smell was abominable. The old female on my first visit to the nest sat extremely close, and although I was standing over her within seven or eight yards, would not leave her young until I fired a shot, upon which she dashed off, dropping almost perpendicularly, and was out of range before I could fire. She flew over the valley and lit upon a high-projecting, rocky pinnacle, upon which I could see her through the telescope, sitting quietly watching all my proceedings. She returned to the nest shortly afterwards, on my having retired to a little distance."

In Algeria the Lämmergeier is said to feed largely on Land Tortoises, which it carries to a great height in the air, and drops upon a convenient rock, so as to break the shell. So much has been written upon the habits of this bird that it would be impossible to give here one tithe of the interesting notes which have been published in various works and periodicals; but no history of the species, however brief, would be complete without a passing mention of the little girl who was said to have been carried off in childhood by one of these birds. The history,

believed by him to be well authenticated, is related by Naumann as follows:—"Anna Zurbuchen, of Hatchern, in Bern Oberland, born in 1760, was taken out by her parents, when she was nearly three years old, when they went to collect herbs. She fell asleep, and the father put his straw hat over her face and went to his work. Shortly after, when he returned with a bundle of hay, the child was gone; and the parents and peasants sought her in vain. During this time Heinrich Michel, of Unterseen, was going on a wild path to Wäppesbach, and suddenly heard a child cry. He ran towards the sound, and a Bearded Vulture rose, scared by him, from a mound, and soared away over the precipice. On the extreme edge of the latter, below which a stream roared, and over whose edge any moment would have precipitated it, Michel found the child, which was uninjured, except on the left arm and hand, where the bird had probably clutched it; its shoes, stockings, and cap were gone. This occurred on the 12th of July, 1763. The place where the child was found was about 1,400 paces distant from the tarn where it had been left asleep. The child was afterwards called *Lämmergeier-Anni*, and married Peter Frutiger, a tailor in Gewaldswyl, where she was still living in 1814."

The circumstantial way in which the above narrative runs appears to leave little doubt of its reality, but it is difficult to give it credence, as the Lämmergeier has but little power in its feet, which resemble those of the Vultures; and most of the stories of its prowess have been discredited by the researches of modern naturalists. Dr. Brehm observes:—"To my intense astonishment, the Spanish hunters did not regard this bird in the slightest degree as a bold, merciless robber: all asserted that it fed on carrion, especially bones, only attacking living animals when driven by necessity. They called it 'Quebranta-Huesos,' or the 'Bone-smasher,' and assured me that this favourite food was broken in a singular manner. My later observations proved nothing which would justify my treating their statements as otherwise than correct, so I was forced to come to the conclusion that the Lämmergeier had been much maligned. Since my first account of this bird, I have read a number of communications from other observers, and gather from the whole that the Bearded Vulture is nought else than a weak, cowardly bird of prey, gifted neither in mind nor body to any great extent, and one that but rarely carries away small mammals. Its food usually consists of bones and other carrion."

Mr. Hudleston met with the Lämmergeier in Greece, where, however, it was not common, and he writes of its habits as observed by him:—"He is not a demonstrative bird like the Griffon, who may be seen sailing about at a great height in the air, sometimes alone, but more often in troops of from half a dozen to fifty, revolving in endless circles round each other, that no corner may remain unseen. The Lämmergeier, on the contrary, may be observed floating slowly, at a uniform level, close to the cliffs of some deep ravine, where his shadow is perhaps projected on the wall-like rocks. If the ravine has salient and re-entering angles, he does not cut across from point to point, but preserves the same distance from the cliff; and when he disappears in any natural fissure, you feel sure of the very spot where he will emerge on turning the corner of the precipice. Marrow-bones are the dainties he loves the best: and when the other Vultures have picked the flesh off any animal, he comes in at the end of the feast and swallows the bones, or breaks them and swallows the pieces, if he cannot get the marrow out otherwise. The bones he cracks by taking them to a great height and letting them fall on a stone. This is probably the bird that dropped a Tortoise on the bald head of poor old Æschylus. Not, however, that he restricts himself, or the huge black infant that he and his mate are bringing up, in one of the many holes with which the limestone precipice abounds, to marrow, turtle, bones, and similar delicacies: neither lamb, hare, nor kid comes amiss to him—though his power of claw and beak being feeble for so large a bird, he cannot tear his meat like other Vultures and Eagles. I once saw a mature bird of this species which had evidently swallowed a bone, or something uncommonly indigestible, close to the *abattoir* at Athens. He was in a very uncomfortable attitude, and appeared to be leaning on his long tail for support. After riding round in gradually decreasing circles till within ten yards, I dropped off horseback and made a rush at him, but he just managed to escape, and then rising slowly till about the height of the Acropolis, made off towards the gorge of Phylæ, where there is an eyry.

"The Lämmergeier has an extremely ugly countenance; this becomes perfectly diabolical when he is irritated, and shows the bright red round his eyes. Altogether, what with his black beard, rufous

breast, and long, dark tail, he is an awful-looking beast, and has the reputation of committing divers evil deeds—such, for instance, as pushing lambs and kids, and even men, off the rocks, when they are in ticklish situations. Nevertheless, he is a somewhat cowardly bird, has a feeble, querulous cry, and will submit to insults from a Falcon not a fourth his size or weight."

Von Tschudi says that in Switzerland it will capture Hares, Martens, Squirrels, Crows, and Woodcocks, and he states that a stomach was found to contain five pieces of Bullock's ribs two inches thick and from six to nine inches long, a lump of hair, and the leg of a young Goat from the knee to

BEARDED EAGLE, OR LÄMMERGEIER.

the foot. The bones were perforated by the gastric juice, and partly reduced to powder. The stomach of another Lämmergeier, examined by Mr. Schinz, contained the large hip-bone of a Cow, the skin and fore-quarters of a Chamois, many smaller bones, some hair, and a Heath-cock's claws. Should a Lämmergeier see an old Chamois or a Sheep or Goat grazing near a precipice, it will whirl round and round, trying to torment and frighten the creature till it runs to the edge of the cliff, and then, falling down upon it, the bird not unfrequently succeeds in pushing it into the abyss below with one stroke of its wings. Diving down after its mangled victim, it will begin by picking out its eyes, and then proceed to tear open and devour the body. It is only the smaller class of booty, such as Foxes, Lambs, or Marmots, which can be carried off by the Lämmergeier, as its feet and claws, as we have already remarked, are comparatively weak.*

In the Himalayas, where the species is also tolerably plentiful, its habits vary somewhat, and it

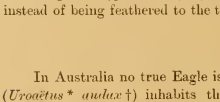
* "Sketches of Nature in the Alps."

not unfrequently comes close to habitations for offal or bones, and behaves in a very Vulturine manner. Captain Hutton writes:—"Marvellous, indeed, are the stories told, both by natives and Europeans, of the destructive habits of this bird, and both accounts, I fully believe, have scarcely a grain of truth in them: all I can positively say on the point, however, is that I have known the bird well in its native haunts for thirty years and more, and never once, in all that time, have I seen it stoop to anything but a dead carcase. As to carrying off hens, dogs, lambs, or children, I say the feat would be utterly impossible, for the creature does not possess the strongly-curved, sharp-pointed claws of the Eagle, but the far straighter and perfectly blunt talons of the Vulture. Day after day I have seen them sweeping by along the face of the hill, like the wandering Albatross at sea, and, like it, ever in search of offal, which, when found, is not swept off the ground after the manner of the Kite, but the bird alights upon it, as it would upon a Bullock, and then, if the morsel is worth having, devours it on the spot, and again launches itself upon its wide-spread wings and sails away as before. There is no sudden stooping upon a living prey, as with the Falcon tribe, but its habits and manners in this respect are, as far as I have seen, entirely Vulturine."

The Lämmergeier measures about three feet and a half in length, and its outspread wings often extend to as much as nine feet in expanse. A second species is found in Africa, the Southern Lämmergeier (*Gypaëtus ossifragus*), which differs from the European one, in having the tarsus bare, instead of being feathered to the toes.

THE TRUE EAGLES (*Aquila*).

In Australia no true Eagle is found, but a very powerful bird called the WEDGE-TAILED EAGLE (*Uroaëtus* audax*†) inhabits that country, differing from all its more northern relations in its very long and wedge-shaped tail, which is like that of the Lämmergeier.



EYE OF EAGLE, SHOWING CRYSTALLINE LENS. (*After Yarrell.*)

The true Eagles have a very powerful bill, with a festoon distinctly marked in the edge of the upper mandible, which is, however, different from the toothed bill of the Falcons, to be considered presently. They nearly all possess a large bony shelf over the eye, which may serve to protect that organ from the sunlight during some of the aërial excursions the bird makes.

The orb of the eye in the Eagles is supported by a ring of bony plates, numbering fifteen in the Golden Eagle. These bony plates are capable of slight motion upon each other. The figure represents the crystalline lens of the same bird, the lens being subject to great variety of form in different birds. In the Eagle the proportion of the axis to the diameter of the lens is as $3\frac{8}{10}$ to $5\frac{7}{10}$; in the Eagle Owl, which seeks its prey at twilight, the relative proportions of the lens are as $6\frac{7}{10}$ to $7\frac{8}{10}$; and in the Swan, which has to select its food under water, the proportions of the lens are as 3 to $3\frac{8}{10}$. Birds have also the power of altering the degree of the convexity of the cornea. With numerous modifications of form, aided by delicate muscular arrangement, birds appear to have the power of obtaining such variable degrees of extent or intensity of vision as are most in accordance with their peculiar habits and necessities.‡

In these birds is found a return of that difference in the size of the sexes which was so noticeable in the Sparrow-Hawks, for in the Eagles the female is decidedly larger than the male. There are two convenient groups into which the Eagles may be divided, according as they have feathered or unfeathered legs. All the true Eagles belong to the first section, all the less noble and Serpent-eating kinds to the latter section. Although they are birds of grand physique, it is a question whether Eagles deserve the position they enjoy for nobility of disposition: they are rapacious it is true, but not always brave, for one Golden Eagle will give way to a Peregrine Falcon, while the grand-looking IMPERIAL EAGLE (*Aquila heliaca*, see figure on p. 235) is said by a good observer in India, Mr. A. O. Hume, C.B., to be no better than a great hulking Kite. He adds:—"Much has been written about the daring and fierceness of this Eagle. I can only say that in India (where possibly the climate is subversive of

* οὐρά, a tail; ἀετός, an Eagle. † *Audax, bold.* ‡ Newton Ed., Yarrell's "British Birds," i., p. 19.

courage), I have never seen the slightest indications of these qualities. I have driven the female off hard-set eggs, and plundered the nest before the eyes of the pair, without either of them flapping a pinion even to defend what a little Shrike will swoop at once to save; and I have seen a couple of Crows thrash one of them soundly. As a rule, this species with us is an ignoble feeder. I have generally found them gorged with carrion, and after a good meal they will sit stupidly on a tree, or any little mud pillar, and permit you to walk within thirty yards of them; but before feeding they are somewhat wary, and can by no means always be secured, even when seen sitting. On more than one occasion I have seen Desert Rats (*Gerbillus erythrurus*) in their crops, and I once shot one of a pair which were busy, on the line of rail at Etawah, devouring a Bandicoot Rat (*Mus bandicota*), which some passing train had cut in two. Occasionally, but rarely, I found that they had eaten Quails and other birds. Once I shot a male which was dancing about on the ground in such an astounding fashion that I killed it to see what the matter was. The bird proved to have been choking. It had swallowed a whole dry shin-bone and foot of an Antelope. The bone apparently could not be got down altogether, and in trying to void it, the sharp points of the hoof had stuck into the back of the roof of the mouth."*

THE GOLDEN EAGLE (*Aquila chrysaëtus* †).

The Golden Eagle is so called from the tawny or golden-brown colour which pervades the feathers of the neck in the old bird. Excepting in certain places in "Caledonia stern and wild," where it is protected, it is a species which is becoming very rare in Great Britain, and but for the intervention of a few large-minded proprietors in Scotland would doubtless ere this have been extinguished. It is a much rarer bird now than the White-tailed Eagle, and the last-named species is often mistaken for it; but a little attention to one point will obviate all fear of a mistake in this respect, the Golden Eagle having at all ages the tarsus feathered to the toes, whereas the Sea Eagle belongs to the bare-legged section of these birds.

A better description of the habits of the Golden Eagle probably does not exist than that given by the late Professor Macgillivray:—

"See how the sunshine brightens the yellow tint of his head and neck, until it shines almost like gold! There he stands, nearly erect, with his tail depressed, his large wings half raised by his side, his neck stretched out and his eye glistening as he glances around. Like other robbers of the desert, he has a noble aspect, an imperative mien, a look of proud defiance; but his nobility has a dash of clownishness, and his falconship a vulturine tinge. Still, he is a noble bird, powerful, independent, proud, and ferocious, regardless of the weal or woe of others, and intent solely on the gratification of his own appetites; without generosity, without honour, bold against the defenceless, but ever ready to sneak from danger. Such is his nobility, about which men have so raved. Suddenly he raises his wings, for he has heard the whistle of the shepherd in the corry, and bending forward, he springs into the air. Oh, that this pencil of mine were a musket charged with buck-shot! Hardly do those vigorous flaps serve at first to prevent his descent; but now, curving upwards, he glides majestically along. As he passes the corner of that buttressed and battlemented crag, forth rush two ravens from their nest, croaking fiercely. While one flies above him, the other steals beneath, and they essay to strike him, but dare not, for they have an instinctive knowledge of the power of his grasp, and after following him a little way they return to their home, vainly exulting in the thought of having driven him from their neighbourhood. Bent on a far journey, he advances in a direct course, flapping his great wings at regular intervals, then shooting along without seeming to move them. In ten minutes he has progressed three miles, although he is in no haste, and now disappears behind the shoulder of the hill. But we may follow him in imagination, for his habits being well known to us, we may be allowed the ornithological licence of tracing them in continuance. Homeward bound, his own wants satisfied, he knows that his young must be supplied with food.

"Over the moors he sweeps, at the height of two or three hundred feet, bending his course to either side, his wings wide spread, his neck retracted, now beating the air, and again sailing

* "Rough Notes on Indian Ornithology," p. 145.

† χρυσός, gold; ἀετός, an Eagle.

smoothly along. Suddenly he stops, poises himself for a moment, stoops, but recovers himself without touching the ground. The object of his regards, a Golden Plover, which he had spied on her nest, has eluded him; and he cares not to pursue it. Now he ascends a little, wheels in short curves, presently rushes down headlong, assumes the horizontal position when close to the ground, prevents his being dashed against it by expanding his wings and tail, thrusts forth his talons, and grasping a poor terrified Ptarmigan that sat cowering among the grey lichens, squeezes it to death, raises his head exultingly, emits a clear, shrill cry, and springing from the ground pursues his journey.

GOLDEN EAGLE.

"In passing a tall cliff that overhangs a small lake, he is assailed by a fierce Peregrine Falcon, which darts and plunges at him as if determined to deprive him of his booty, or drive him headlong to the ground. This proves a more dangerous foe than the Raven, and the Eagle screams, yelps, and throws himself into postures of defence; but at length the Hawk, seeing the tyrant is not bent on plundering his nest, leaves him to pursue his course unmolested. Over woods, and green fields, and scattered hamlets speeds the Eagle, and now he enters the long valley of the Dee, near the upper end of which is dimly seen through the grey mist the rock of his nest. About a mile from it he meets his mate, who has been abroad on a similar errand, and is returning with a white Hare in her talons. They congratulate each other with loud yelping cries, which rouse the drowsy shepherd on the strath below, who, mindful of the lambs carried off in spring-time, sends after them his maledediction. Now they reach their nest and are greeted by their young with loud clamour.

"Let us mark the spot. It is a shelf of a rock, concealed by a projecting angle, so that it cannot

be injured from above, and is too distant from the base to be reached by a shot. In the crevices are luxuriant tufts of *Rhodiola rosea*, and scattered around are many alpine plants, which it would delight the botanist to enumerate. The mineralogist would not be less pleased could he with chisel and hammer reach that knob which glitters with crystals of quartz and felspar. The nest is a bulky fabric, five feet at least in diameter, rudely constructed of dead sticks, twigs, and heath; flat, unless in the centre, where it is a little hollowed and covered with wool and feathers. Slovenly creatures you would think these two young birds, clothed with white down, amid which the larger feathers are seen projecting, for their fluid dung is scattered all over the sticks, and you see that, had the nest been formed more compactly of softer materials, it would have been less comfortable. Strewn around, too, are fragments of Lambs, Hares, Grouse and other birds in various stages of decay. Alighting on the edges of the nest, the Eagles deposit their prey, partially pluck off the hair and feathers, and rudely tearing up the flesh, lay it before their ever-hungry young."

The length of a male Golden Eagle is a little more than two feet and a half, while the female attains at least three feet in dimensions, with a wing three inches longer than that of her mate. The colour of the plumage is dark brown, with a rich tawny hue on the back of the neck and nape, the feathers of these parts being streaked with darker brown; the tail is more or less mottled with grey at the base, and is whiter in younger birds. The latter are often popularly distinguished as the Ring-tailed Eagles. By some authors the Eagle which frequents the mountains is considered to be a different species from that which inhabits the plains, but as far as present experience goes it is the younger birds which are more often met with in the latter localities, being probably driven from their mountain homes by the older birds. The Golden Eagle varies his choice of an eyry in different localities, building in the British Islands generally on a rock, but in many other countries nesting on a tree. It is found all over Europe and Northern Asia, in mountainous districts, extending into China and even into the Himalayas, whence the finest specimens are obtained. In North America also the examples of the Golden Eagle seem to be very large, but are not to be otherwise distinguished from European specimens.

THE KITE EAGLE (*Nespus* malayensis*).

This extraordinary bird bears the above name from its resemblance generally to a Kite, and also from its plumage, which in the young bird is wonderfully Kite-like, so that a dead specimen carelessly examined might be taken easily for one of the latter birds. One moment's search, however, would dispose of the illusion, for no one who has once heard of the foot of this Eagle could ever forget it or mistake it for that of any other raptorial bird, the talons being longer and more slender in proportion to the size of the foot than in any known Eagle; they are also nearly straight. The inner claws are the longest, and that excellent observer, Captain Vincent Legge, points out that they seem "especially adapted for the work of carrying off loose and fragile masses, such as the nests of small birds, as they would naturally form its chief means of grasp when such an object was being held by both feet during the process of flight." This last sentence gives an insight into the habits of the bird, which are on a par with its remarkable structure. It might well be called the "Bird's-nesting Eagle," for it seems to be the only bird of prey which systematically lives by the robbery of smaller birds' nests; only on very rare occasions, and when pressed by hunger, has it been known to attack larger game or worry the poultry-yard. It is almost always on the wing, and the Lepcha-hunters near Darjeeling speak of it as the bird "that never sits down." It is found in the Himalayas and in other wooded districts of India, and occurs but more sparingly in the Malayan peninsula and islands, ranging to some of the Moluccas, but probably visiting the latter only on migration. But it is in Ceylon that it is, perhaps, more plentiful than in any other locality, and the best account of its habits is that given by Captain Legge, whose words are subjoined. "This fine, long-winged Eagle is, on account of the singular structure of its feet and its curious habits, one of the most interesting, but, at the same time, perhaps the most destructive of raptors to bird-life in Ceylon. It subsists, as far as can be observed, entirely by birds'-nesting, and is not content with the eggs and young birds which its keen sight espies among the branches of the forest-trees, but seizes the nest in its talons, decamps with it, and often examines

* νεος, new; πους, a foot: meaning that there was something novel and extraordinary about its foot.

the contents as it sails lazily along. Furthermore, Mr. S. Bligh informs me that he once found the best part of a bird's nest in the stomach of one of these Eagles which he shot in the Central Province. Its flight is most easy and graceful. In the early morning it passes much of its time soaring round the high peaks or cliffs on which it has passed the night, and about nine or ten o'clock starts off on its daily foraging expedition. It launches itself with motionless wings from some dizzy precipice, and proceeding in a straight line, till over some inviting-looking patna-woods it quickly descends with one or two rather sharp gyrations, through, perhaps, a thousand feet, and is in another moment gliding stealthily along just above the tops of the trees. In and out among these, along the side of the wood, backwards and forwards over the top of the narrow strip, it quarters, its long wings outstretched and the tips of its pinions wide apart, with apparently no exertion; and luckless indeed is the Bulbul, Oriole, or Mountain Finch whose carefully-built nest is discovered by the soaring robber." *

The size of the Kite Eagle is about thirty inches in length, and the colour is entirely black, with some indistinct bars of ashy-grey on the tail. Besides the Eagles that have been alluded to already, there are the Hawk-Eagles (*Nisaëtus*), remarkable for their long legs, and the Crested Eagles (*Spizaëtus*), which have a beautiful long crest hanging from the hinder part of the head.

THE COMMON HARRIER EAGLE (*Circaëtus*† *gallicus*).

This, which is also called the "Jean-le-Blanc," is one of the best-known of all the bare-legged section of the Eagles. The genus *Circaëtus*, to which it belongs, contains five species, of which four are peculiar to Africa, the *C. gallicus* being found all over Southern and Central Europe, and extending into India, where it is not at all unplentiful. In its nature this bird is rather sluggish, though in confinement it is very untamable, and wears a thoroughly fierce aspect, as could be seen by any one who examined the specimen in the Zoological Gardens. Its ferocious appearance was heightened by its peculiar eye, which is very large, of a bright yellow, with a very small black pupil, whereas the pupil in most birds of prey is rather large.‡

THE INDIAN SERPENT EAGLE (*Spilornis cheela*).

This is a beautiful bird, having the under surface mottled with white spots or "ocelli." All the Serpent Eagles, of which there are several species, are characterised by a similar style of plumage, and by a full, thick crest of feathers springing from the occiput and hind part of the head. They are found all over India and Ceylon, Southern China, and the Burmese countries, the Malayan Peninsula, Sunda Islands, Borneo, and Celebes. The Ceylonese species, which is a small race of the Indian bird, is stated by Layard to feed on Snakes, Lizards, and other reptiles and insects, and to be particularly partial to the large trees on the banks of tanks, from them swooping down on the frogs which came up to sun themselves on the floating logs or reeds. The Indian species of Serpent Eagle is a powerful bird, and is said to capture Pheasants during the breeding season and bring them to the nest. Mr. Hume has generally found small Snakes in their stomachs; once as many as fifty together were found, all scarcely bigger than large Worms; and an instance was brought to his knowledge of a Cobra some two feet and a half long having been found dead, but uninjured, in one of these birds' stomachs. Mr. Thompson, a frequent contributor to Mr. Hume's "Rough Notes," tells of one which he had alive, and which was kept along with two little Indian Owls (*Carine brama*), a Carrion Crow, and three large green Woodpeckers, and who killed and ate up every one of the latter, though well supplied with other fresh meat.

THE BATELEUR EAGLE (*Helotarsus*§ *ecaudatus*‖).

This is a very remarkable bird, which might also with propriety be called the Short-tailed Eagle, as it is the only species known in which the wings exceed the tail in length. It is found in Africa only, where it is by no means rare in the southern and north-eastern quarters of the continent.

* "Birds of Ceylon," p. 49.

† *κίρκος*, a Harrier; *ἀετός*, an Eagle.

‡ Ibis, 1865, p. 253.

§ *ἕλω* (*αἱρέω*), to lift; *ταρσός*, a tarsus.

‖ Ecaudatus, Latin, meaning "without tail," on account of its shortness.

In Damara Land, according to Mr. Andersson, it builds its nest on trees, selecting generally one of such a terribly thorny nature that the nest is always difficult of access. Occasionally, however, a rock is selected for the breeding-place. When in captivity, this bird changes the colour of the face, exactly as the Brazilian Caracara already alluded to; the bare skin round the nostrils and eyes, which is generally brilliant coral-red, fading to pale orange-yellow.

BATELEUR EAGLE.

The Bateleur Eagle is about two feet in length, and has an enormous crest of plumes. The colour is black, with a large maroon-coloured patch on the shoulders and on the back, the tail being also of this colour. Sometimes individuals with pale, cream-coloured backs are found; but at present it is not known whether these are a different species, or whether they constitute only a pale variety of the ordinary Bateleur.

THE WHITE-TAILED EAGLE (*Haliætus albicilla* *).

Sea Eagles are absent from South America, but probably from no other country of the globe. Both Europe and North America are inhabited by large and powerful species; and throughout Africa and Madagascar the handsomely-marked species *H. vocifer* occurs. One of the most widespread is the White-bellied Sea Eagle; it is found round the coasts of Australia and all the Molucca Islands, ranging as far as India and Ceylon, and as high as Cochin China.

The White-tailed Eagle, which, from its being an inhabitant of the British Islands, is the species most familiarly known of all the Sea Eagles, is still met with in some of the northern parts of

* ἁλιάετος, a Sea Eagle.

Scotland, and in the Hebrides; but as it is a bird which creates a good deal of havoc among lambs at certain periods of the year, the war of extermination which has been waged against it has now contributed considerably to the increasing rarity of the species on these coasts. The breeding of this Sea Eagle has been well described by Mr. Woolley.* He says:—"On the coasts, the Sea Eagle chooses a roomy and generally sheltered ledge of rock. The egg which Mr. Hewitson figures (Eggs, Br. B., ed. 3, pl. iv., fig. 2) is one of two which I took on the 23rd April, 1849, on one of the most northern points of our island. The nest was very slightly made of a little grass and fresh heather loosely put together, without any sticks; but two or three 'kek' stalks were strewn about outside. There was a good thickness of guano-like soil upon the rock, which made much nest unnecessary. Two or three Guillemot's beaks, the only unmanageable part of that bird, were not far off. The eggs were laid two days before when I went to reconnoitre; and I never shall forget the forbearance which a friend who was with me showed, at my request, as he lay, gun in hand, with the hen Eagle in full view upon her nest not forty yards below him. Her head was towards the cliff, and concealed from our sight; whilst her broad back and white tail, as she stood bending over her nest on the grassy ledge, with the beautiful sandstone rock and sea beyond, completed a picture rarely to be forgotten. But our ears, and the air we breathe, give a finish to Nature's pictures which no art can imitate; and here were the effects of the sea, and the heather, and the rocks, the fresh warmth of the northern sun, and the excitement of exercise, while the musical yelping of the male Eagle came from some stand out of sight. Add to all this the innate feeling of delight connected with the pursuit of wild animals, which no philosopher has yet been able to explain further than as a special gift of our Great Maker, and then say whether it is not almost blasphemy to call such a scene a 'picture!' Upon this occasion, I made some remark to my friend, when the hen Eagle showed her clear eye and big, yellow beak, her head full of the expression of wild nature and freedom. She gave us a steady glance, then sprang from the rock, and with 'slow winnowing wing'—the flight-feathers turning upwards at every stroke—was soon out at sea. Joined by her mate, she began to sail with him in circles farther and farther away, till quite out of sight, yelping as long as we could hear them, Gulls mobbing them all the time. To enjoy the beauties of a wild coast to perfection, let me recommend any man to seat himself in an Eagle's nest. The year before this I took the young ones out of the same eyry late in July. It was my first attempt at an Eagle's stronghold, and I shall never forget the interest of the whole affair; a thunderstorm coming on just before, making it necessary to cut drains in the peat with our knives, to divert the torrents of water; our councils about the best mode of attaching the ropes; the impertinence of a young lad who, stationed to watch for my signals, was rendered quite useless by his keen sense of the ridiculous on seeing me, in my inexperience, twisting round and round at the end of the rope; the extraordinary grandeur everything assumed, from the nest itself; the luxurious feeling of exultation; the interest of every plant about it—I know them all now; the heaps of young Herring-Gulls' remains, and the large fish-bone; but, above all, the Eaglets fully able to fly, and yet crouching side by side, with their necks stretched out and chins on the ground, like young Fawns, their frightened eyes showing that they had no intention of showing fight.

"Very gently, as a man 'tickles' trout, I passed my hand under them, and tied their legs together, and then tried to confine their wings. They actually allowed me to fasten a handkerchief round them, which, however, was soon shaken off when they began to be pulled up. When the men had raised me, the string attached to my waist lifted one Eaglet, and presently the second came to the length of his tether. Great was the flapping of wings, and clutching at rocks and grass. I had many fears that the string or the birds' legs must give way; but, after much hard pulling, I got them safely to the top, and they are now (1853) alive at Matlock amongst rocks, where I hope they may breed; but, though five years old this season, they have not yet quite completed the adult plumage. Their dutiful parents never came near them in their difficulties; but I am happy to say that in 1850 (the year after I took their eggs), they carried off their young, through the interest I was able to exert in their favour. They had shifted their position; and they changed again in 1851 to a rock with an aspect quite different, and more than a mile away. In 1847, to please the shepherds, the young were shot in the nest, which was built in the spot where I visited it the two following years. There was no sea-weed about this nest either time that I saw it; but a friend writes me word, that two which

* "Ootheca Woolleyana," p. 47.

he examined last year on the sea-cliffs of this island, and which he carefully described to me, were principally made of that material, as Mr. Hewitson also had found them in the Shetland Islands. On one of these two occasions, the old Eagle made a dash near my informant, with a 'fearful scream,' and such was the tremendous character of the rocks, that his 'hair gets strong' when he thinks of them. These two nests, both occupied, were not more than a mile and a half apart."

WHITE-TAILED EAGLE.

THE SWALLOW-TAILED KITE (*Elanoides furcatus*).

The forked tail which is characteristic of the Kites reaches in the present species its greatest development, so that the name of Swallow-tailed Kite is by no means inappropriate. On five occasions the bird has been captured in England, and it is doubtless during its migration that the bird is driven to Britain by some adverse wind. Its range is extensive, as it is numerous during the summer in some of the southern States of North America, and it migrates to South America, whence it frequently appears in collections from Brazil and Columbia. Mr. Audubon gives the following account of the Swallow-tailed Kite:—"The flight of this elegant species of Hawk is singularly beautiful and protracted. It moves through the air with such ease and grace, that it is impossible for

any individual, who takes the least pleasure in observing the manners of birds, not to be delighted by the sight of it whilst on the wing. Gliding along in easy flappings, it rises in wide circles to an immense height, inclining in various ways its deeply-forked tail, to assist the direction of its course; dives with the rapidity of lightning, and, suddenly checking itself, re-ascends, soars away, and is soon out of sight. At other times, a flock of these birds, amounting to fifteen or twenty individuals, is seen hovering around the trees. They dive in rapid succession amongst the branches, glancing along the trunks, and seizing in their course the insects and small lizards of which they are in quest. Their motions are astonishingly rapid, and the deep curves which they describe, their sudden doublings and crossings, and the extreme ease with which they seem to cleave the air, excite the admiration of him who views them while thus employed in searching for food.

"In the States of Louisiana and Mississippi, where these birds are abundant, they arrive in large companies in the beginning of April, and are heard uttering a sharp plaintive note. At this period I generally remarked that they came from the westward, and have counted upwards of a hundred in the space of an hour, passing over me in a direct easterly course. At that season, and in the beginning of September when they all retire from the United States, they are easily approached when they have alighted, being then apparently fatigued, and busily engaged in preparing themselves for continuing their journey, by dressing and oiling their feathers. At all other times, however, it is extremely difficult to get near them, as they are generally on wing through the day, and at night rest on the highest pines and cypresses, bordering the river-bluffs, the lakes, or the swamps of that district of country.

"They always feed on the wing. In calm and warm weather they soar to an immense height, pursuing the large insects called *Musquito Hawks*, and performing the most singular evolutions that can be conceived, using their tail with an elegance of motion peculiar to themselves. Their principal food, however, is large Grasshoppers, Grass Caterpillars, small Snakes, Lizards, and Frogs. They sweep close over the fields, sometimes seeming to alight for a moment to secure a Snake, and holding it fast by the neck, carry it off, and devour it in the air. When searching for Grasshoppers and Caterpillars, it is not difficult to approach them under cover of a fence or tree. When one is then killed, and falls to the ground, the whole flock comes over the dead bird, as if intent upon carrying it off. An excellent opportunity is thus afforded of shooting as many as may be wanted; and I have killed several of these Hawks in this manner, firing as fast as I could load my gun.

"The Fork-tailed Hawks are also very fond of frequenting the creeks, which, in that country, are much encumbered with drifted logs and accumulations of sand, in order to pick up some of the numerous Water-snakes which lie basking in the sun. At other times they dash along the trunks of trees, and snap off the pupæ of the Locust, or that insect itself. Although when on the wing they move with a grace and ease which it is impossible to describe, yet on the ground they are scarcely able to walk.

"I kept for several days one which had been slightly wounded in the wing. It refused to eat, kept the feathers of the head and rump constantly erect, and vomited several times part of the contents of its stomach. It never threw itself on its back, nor attempted to strike with its talons, unless when taken up by the tip of the wing. It died from inanition, as it constantly refused the food placed before it in profusion, and instantly vomited what had been placed down its throat."

THE COMMON KITE (*Milvus ictinus**).

Times have changed in England since the number of Kites to be seen flying about London Bridge could form a subject of astonishment to a foreign traveller visiting that country; but less than three hundred years ago this was the case, though now the species has been all but banished from the land. It may still occasionally nest in some parts of Wales and of Scotland; but in the latter country places where formerly the species bred plentifully now know it no more. The Kite builds its nest of sticks on a large tree, but occasionally also on rocks, and it is generally composed of a mixture of materials, such as bones, &c., and the lining usually contains a good many rags; so that Shakspere, with the knowledge of natural history which always distinguished him, was quite right when he said—

"When the Kite builds, look to lesser linen."

* ἰκτῖνος, a Kite.

The presence of the Kite in London was useful in the old days, as its food consists by preference of offal, though it also devours Moles, Frogs, and unfledged nestlings, Rabbits, Snakes, and fish. The forked tail of this species—which serves as a rudder to the bird when flying, as it often does, in circles aloft—easily distinguishes it from all other British birds of prey. The length of the bird is about two feet, and the general colour of the upper plumage is rufous, most of the feathers being edged with that colour. Below, it is rufous-brown, with a narrow streak of blackish down the feathers; the quills are black; the tail rufous-brown, deeply forked, and crossed with seven or eight bars of black. The species is found all over Europe, but becomes gradually rarer in the eastern parts.

COMMON KITE.

THE EUROPEAN HONEY-KITE
(Pernis apivorus).

This bird is generally known as the Honey-Buzzard, though from the reticulations on the hinder aspect of the tarsus it has evidently nothing to do with those birds, even if its soft and kite-like plumage did not show its affinities to the Kites. Its nostril is also peculiar, and is closed in by a membrane, which doubtless forms a protection from the stings of insects when the bird is attacking a Bee's or Wasp's nest. Its habits have been well described by Brehm.* This bird is, perhaps, the most timid of all European birds of prey, but is remarkable for its good temper. Its movements are in the highest degree clumsy; its flight is bad, heavy, and slow, and is generally a short one, and the bird shows a great disinclination to rise to any considerable height in the air; in short, its whole bearing evinces the most lazy disposition. It will sit for hours on a stone boundary wall, on a solitary tree or sign-post, or on some other elevated spot, quite contented, watching its prey, which consists of the following:—Insects of all descriptions, Beetles, Caterpillars, Dragon-flies, Gadflies, Worms, Frogs, Snakes, Lizards, and destructive Rodents, which form its principal food; besides which it is very fond of hunting for the nests of the Humble-bee and Wasp, and of feeding on their larvæ. This bird also, unfortunately, destroys the young, and especially the eggs, of such of the smaller birds as it comes across while hunting for insects; this causes it to be looked upon as a disagreeable and hateful enemy by all birds. Crows and Rooks mob the Honey-Buzzard with almost the same eagerness as they chase the Eagle-Owl, and all small birds make a great noise at its appearance. In the summer it also feeds on buds, blossoms, bilberries, other wood-berries, and even leaves. This habit distinguishes it from all other German birds of prey.

"The Honey-Buzzard reaches us somewhat late in the year, and commences to build its nest when the other Raptors have hatched their broods. The nest is very flat, and is placed on the highest of our forest trees; it is principally constructed of green twigs, mixed with dead sticks, and is lined with moss, hair, and feathers. It generally contains three eggs, of a rusty

* "Bird-life," p. 543.

yellow ground, very thickly blotched and spotted with dark reddish-brown. They are somewhat small and rather long in shape. Of these rarely more than two are hatched. The young ones are at first fed with Caterpillars, Flies, Beetles, Worms, &c., which the old birds collect in their crops, and then throw up; later they are treated to pieces of Wasps' nests filled with larvæ, Frogs, Mice, young birds, &c. The parent birds still continue to feed their young long after the latter have left the nest. Both young and old birds remain in company almost till the moulting season comes round, when they migrate more to the southward."

The Honey-Kite inhabits, during the summer, the greater part of Europe, and flies away to Africa to pass the winter. In India it is represented by a species which goes through similar changes of plumage, but may always be recognised by its long crest. The phases through which the Honey-Kite passes are most remarkable, the bird being sometimes nearly all white, at other times all black; and this plumage seems to occur at any age, sometimes in youth, sometimes in old age; and hence this is called a melanism (*μέλας*, black). Many birds of prey are subject to this melanism, but none more so than the Honey-Buzzards, and their representatives in America, the Tooth-billed Kites (*Leptodon*).

ANDERSSON'S PERN (*Machærhamphus* * *Anderssoni*).

This remarkable bird bears the name of one of the most intrepid, as well as one of the most unassuming, of African travellers, the late Charles John Andersson, who discovered it during his residence in Damara Land in South-western Africa. So rare is it, and so difficult to obtain, that he only managed to procure two specimens in the space of ten years, though constantly on the look-out for the bird. He writes concerning it:—"On the 10th of March, 1865, I obtained one specimen, a female, of this singular bird at Objimbinque, Damara Land. It was shot by my servant, who observed another, probably the male. I imagine that I have myself observed it once or twice in the neighbourhood of Objimbinque just before dusk. When brought to me I instinctively suspected the bird to be a feeder at dusk or at night, and called out, 'Why, that fellow is likely to feed on Bats!' And truly enough so it turned out; for on dissection an undigested Bat was found in the stomach; and in another specimen, subsequently killed by Axel, there were several Bats in the stomach."† It is probably owing to this habit of feeding in the evening that the bird is so difficult to procure, as is the case with many of the Goat-suckers, which are also night-feeding birds. Since Mr. Andersson's death, two or three specimens of his Pern have been sent from Madagascar, but in the intervening portions of the African continent it is as yet unknown.

The colouring of this species is plain, being of a chocolate-brown colour, with a long crest springing from the back of the head; above the eye is a white spot, and another below the eye; the throat and chest are white, with a streak of dark brown down the centre of the throat; the quills and tail are banded the bars showing paler below. The length of the bird is about seventeen inches.

Only one other species of the genus *Machærhamphus* is known, and this is Westermann's Pern (*M. alcinus*), which is an inhabitant of Malacca, where it is almost as rare as Andersson's Pern is in Africa. It has lately been sent from South-eastern New Guinea, and may ultimately be found to inhabit some of the Moluccas.

THE FIFTH SUB-FAMILY.—THE FALCONS (*Falconinæ*).

In all the true Falcons and in the allied genera the bill, which was simply festooned in the Eagles, Kites, and Buzzards, becomes very distinctly toothed, and in some genera even two teeth are present. In these birds, too, the cere is strongly shown, and is generally of a bright yellow colour.

THE CUCKOO-FALCONS (*Baza*).

These birds have the soft plumage of a Honey-Kite, and yet possess the toothed bill of a Falcon, so that they are placed among the Falconinæ; but, because of their Kite-like plumage, they follow close to the Perns and Honey-Kites. They not only possess the usual tooth of the Falcon's bill, but a second is actually present, so that there is no difficulty in recognising a member of the genus *Baza*.

* *μάχαιρα*, a sharp knife; *ῥάμφος*, a bill.

† Andersson's "Birds of Damara Land." Edited by J. H. Gurney, 1872, p. 22.

The American Cuckoo-Falcons (*Harpagus*) are the only other birds of prey which have a double-toothed bill.

The name of "Cuckoo"-Falcon has been given to these birds on account of their actual resemblance to a Cuckoo, in the grey colour of the back with the reddish bars on the under surface. They have also a very large yellow eye. The distribution of the genus *Baza* is singular, and it is one of those forms which does not occur in Europe, but exhibits the affinity which is often seen between certain African and Indian birds. About nine different kinds are known, each having its own limited range. Thus Swainson's Cuckoo-Falcon (*B. cuculoides* *) is found in the forest country from Senegambia to Gaboon in West Africa, and is replaced by *Baza Verreauxi* in the forests of Natal. In Madagascar a third species (*B. madagascariensis*) occurs, and on crossing the Indian Ocean a fourth kind (*B. ceylonensis*) is found inhabiting Ceylon. Malacca and the Sunda Islands have their own *Baza sumatrensis*, the Philippines *B. magnirostris*, the island of Celebes *B. erythrothorax*, the Moluccas and New Guinea *B. Reinwardtii*, and Northern Australia, *B. subcristata*. None of these birds appear to be migratory, and their geographical distribution is interesting when traced out on a map of the world.

From their shy and retiring habits, but little has been recorded of their life. Verreaux's Cuckoo-Falcon is said to frequent the dense bush in Natal, and Captain Harford shot one in that country while engaged upon an ant-hill, and their food appears to consist of Grasshoppers and Mantidæ, while another observer took from the stomach of one of these birds remains of a green Mantis, of Locusts, and of a Chameleon. This species is one of the largest of the Cuckoo-Falcons, measuring seventeen inches in length, and the colour is dark ashy-grey; deeper ash-colour on the head and crest; the sides of the face, throat, and chest, are clear ashy; the breast white, banded across with pale rufous brown; the under tail-coverts being pure white; both the wings and tail are barred with dark brown. The sexes of these birds differ very little in size.

THE FALCONETS (*Microhierax*†).

This name is applied to a genus of tiny Falcons, which are peculiar to the Indian region. One of them, the Indian Falconet (*Microhierax cærulescens*), is found in the Himalayas and the Burmese countries. A second one is peculiar to Assam, a third to the Philippine Islands, and a fourth to the interior of China, while the fifth and remaining species is found in the Malayan Peninsula and the Sunda Islands.

Not one of these little Hawks is seven inches in length, and even to this day there are many authors who think that they are Butcher-birds or Shrikes, and not Hawks at all. They are, however, true Falcons, though of very small size, and are said to be used by native chiefs for hawking insects and Button-quails, being thrown from the hand like a ball; but this story has been discredited of late, the Besra, a small Sparrow-Hawk, being probably the bird alluded to. The Falconets are known to sit solitary on high trees, and according to native accounts they feed on small birds and insects.

THE PEREGRINE FALCON (*Falco peregrinus*‡).

This noble bird justifies his name of *peregrinus*, by his distribution over the earth's surface. The ordinary Peregrine, which is still found in suitable places breeding on British coasts, is met with all over Europe and Northern Asia, ranging into South Africa and India in winter, extending throughout China to the Sunda Islands, and the Philippine Archipelago. In North America he is also widely distributed, and is as plentiful as in Europe. In the southern hemisphere the Peregrines, though strictly of the same type as the European bird, are always darker in colour, and have blacker faces and heads. The Australian Peregrine is called *Falco melanogenys*,§ and extends its range from the Australian continent to New Caledonia and the New Hebrides, and as far north as Java. In South Africa the resident Peregrine is a very small, dark-coloured bird, and is called *Falco minor*. This species is also met with in North-eastern Africa, and even ranges into the Mediterranean, as it has been shot in Rhodes, Sardinia, and Morocco. Again, in Chili, another dark-faced form occurs, the *Falco nigriceps*,‖ not unlike its Australian relative.

To write a history of the Peregrine Falcon would be almost to write a history of falconry, and

* Lit., like a Cuckoo. † μικρός, small, tiny; ἱέραξ, a Hawk. ‡ A wanderer.
§ μέλας, black; γένυς, a cheek. ‖ *Nigriceps*, black headed

although it would be beyond the limits of the present work to enter deeply into the subject, a few words must be said about it here. The art of falconry probably came from the East, where it is still practised, and an ancient bas-relief was found by Sir Austen Layard, among the ruins of Khorsabad, depicting a falconer with a Hawk on his wrist, thus proving the antiquity of the pursuit. In Great Britain it was formerly much in vogue, and in Salvin and Brodrick's work on "Falconry in the British Islands" there will be found an interesting *résumé* of the art, as performed in Great Britain, from ancient times down to the present. It is lamentable to think of the way in which these noble birds, once the pride and favourite of monarchs, are now shot down and classed as vermin. The strict way of preserving game which has been common of late years, and the general use of firearms, have, no doubt, been the chief causes of the destruction of the larger Falcons, and it will take some time to disabuse the vulgar prejudices of gamekeepers, and of some proprietors, as to the mistake that is made in killing off every kind of raptorial bird indiscriminately. A protest which was penned by Mr. G. E. Freeman, in his "Falconry," is worthy of reproduction here:—"All Hawks, when they have a choice, invariably choose the easiest flight. This fact is of the last importance in the matter before us. I confess that I at once give it the chief place in this argument. Who has not heard of the Grouse disease? It has been attributed, sometimes respectively, and sometimes collectively, to burnt heather; to heather poisoned from the dressings put on Sheep; to the Sheep themselves cropping the tender shoots and leaves of the plant, and thus destroying the Grouse's food; to the tape-worm; to shot which has wounded but not killed; and perhaps to other things besides. It may be, I doubt not, correctly referred to any or to all of these. Of this, however, there appears no question that from whatever cause it springs it is *propagated*. A diseased parent produces a diseased child. Now, I say that when every Hawk is killed upon a large manor, the balance of Nature is forgotten, or ignored; and that Nature will not overlook an insult. *She* would have kept her wilds healthy; destroy her appointed instruments, and beware of her revenge!"

PEREGRINE FALCON.

The Peregrine Falcon has always been celebrated with falconers for its superior dash and courage. The female is much the larger and more powerful bird, and is called the "Falcon," the male being known as the "Tiercel." The young birds reared from the nest are called "Eyes," and the immature specimens, from their more rufous colour, are distinguished as the "Red Falcon" and the "Red Tiercel." When a bird has been caught wild in the full plumage it is called "Haggard." The principal flight of the "Falcon" was at the Heron, and many anecdotes are told of the encounters between these two antagonists in mid-air. The evidence of Falconers, however, goes to show that the impalement of the Hawk by the Heron's bill is a rare occurrence, and it is only when the birds come to the ground that the presence of the man is required to rescue the Falcons from their dangerous foe. The Heron, on being pursued, endeavours to avoid his pursuer by mounting high into the air, the Falcon meanwhile doing his best to rise above him and strike the quarry to the ground. Generally,

two Falcons were employed in the chase, and while the Heron avoided the stoop of one by changing his position suddenly, the other was ready to stoop from above, until, by a successful swoop, the Heron would be mastered and borne to the ground with the two Falcons in close embrace. Then was the time for the good falconer to be at hand to save his Hawks from the Heron. In a wild state the Peregrine feeds on Grouse of all kinds, Pheasants, Partridges, Ducks, Pigeons, Plovers, &c., but it does not so often visit the poultry-yard as the other Hawks, preferring the open country or the sea-coast. In this latter locality, the Falcon feeds on the various sea-birds, such as the Puffins, Auks, Guillemots, and as it flies back to its nest with food for its young, it will sometimes in very wantonness rip up a Gull or other sea-bird if it happens to get in the way as it rushes by. The nest is generally large, and composed of sticks and herbaceous plants, excepting in localities were none of the latter exist, when it is made of grass. The site chosen is some sea-cliff or high precipice inland, where there is sure to be some difficulty in reaching the nest, which is generally harried by means of a rope. They build in the same localities for years together, and Professor Newton gives an interesting record of such an occurrence,* when he mentions a hill in Lapland, where a pair of Falcons had a nest when it was visited by the French astronomical expedition in 1736, a nest being re-discovered in the same place in 1799 by Captain Skjöldebrand, and again by the late Mr. Woolley, in 1853. Near the site of its nest the Peregrine brooks no intruder, and will even attack an Eagle, an instance having been recorded of one of the latter birds being stunned and brought to the ground by a Peregrine, who broke its own wing in the attempt, and was liberated by the shepherds to mend its wing as best it could, in gratitude for having delivered their aquiline enemy into their hands.

HOODED FALCON.

In Holland, where until recent years hawking was largely carried on under the auspices of the king, there is a well-known place, called Valkenswaard, where a good many Hawks are trapped every autumn during migration, and it is from the neighbourhood of this village that many of the most celebrated falconers have come. At the same time England has also produced many celebrated adepts at the art, which is generally carried on from father to son; and one of the Barr family, with a high reputation as a falconer, a few years ago exhibited his trained birds in the neighbourhood of London. The writer has also seen some fine sport in Huntingdonshire, with Lord Lilford's Hawks, in a large extent of open country near Great Gidding.

FALCON'S HOOD.

The male Peregrine is of a bluish-grey colour, narrowly barred with black, the wings darker; the cheeks, ear-coverts, and moustache, black, the entire sides of the head being sometimes of this dark aspect; underneath, the body is white, with more or less of a reddish tinge, and crossed with black bars; tail grey, broadly barred with black and tipped with white. The length is about fifteen inches, that of the female about seventeen; and the wing is fourteen inches and a half in length instead of about twelve, as in the male. In plumage the hen bird is very similar, but is generally of a richer rufous hue below.

Besides the Peregrine Falcons there are a host of smaller species of the genus *Falco*, varying much from the above birds in size and style of colour, but of exactly the same form, and having much the same habits. The Hobby (*Falco subbuteo*) and the Merlin (*F. æsalon*) represent these smaller Falcons in the British Islands.

* "Ootheca Woolleyana," p. 98.

THE GREENLAND JER-FALCON (*Hierofalco candicans*).*

Besides the Peregrine, there were used in falconry, in England, the Noble, or Jer-Falcons, birds which were much prized, although they did not possess the same fire and dash in pursuit of their quarry exhibited by the former bird. There are five distinct kinds of these northern Jer-Falcons, without mentioning the Saker Falcon of South-eastern Europe, which also belongs to the genus *Hierofalco*. The best known is the Greenland Jer-Falcon, which, as its name implies, is an inhabitant of Greenland and North America, young birds only occurring in the British Islands during migration. This species is nearly pure white in colour when fully adult, the back and wings retaining small spots of black, the entire head and breast, and especially the tail, becoming pure white as the bird gets older and loses the spots and bars which characterise its immature dress. An unfailing mark by which a Greenland Jer Falcon can be told at any age is the light yellowish bill and cere, and the absence of arrow-shaped bars on the flanks, which in young birds are longitudinally streaked with brown, but are never barred. All the other Jer-Falcons have distinct bars across the flanks, as well as bluish bills and regularly barred tails. They are four in number, the Norway Jer-Falcon (*H. gyrfalco*), the Iceland Jer-Falcon (*H. islandicus*), Holböll's Jer-Falcon (*H. holbölli*), and the Labrador Jer-Falcon (*H. labradorus*). They are nearly all peculiar to the countries whose names they bear, the Norway bird not occurring anywhere out of Europe and Northern Asia, one specimen having been known to occur in England; it seems also to emigrate to Central Asia, as a single bird was procured during the last Yarkand Mission. All the Jer-Falcons have shorter toes than the Peregrines, in which the outer toe is very long, while in the other birds the outer and inner toes are about equal in length.

When in a wild state the Greenland Falcon feeds upon Ptarmigan, Geese, and on the sea-birds which frequent the cliffs where it takes up its abode. It evinces great courage in defending its nest.

THE KESTRELS (*Cerchneis*).

These form a group of short-toed Hawks, like the foregoing, but are much more numerous in species, and are found distributed all over the world, with the exception of some of the Oceanic Islands. More than twenty different kinds of Kestrel are recognised by naturalists, and they are more insect-feeding birds than the bolder and nobler Falcons which have just been spoken of. The commonest and best known of all is

THE COMMON KESTREL, OR WIND-HOVER (*Cerchneis tinnunculus*).†

This species gains its name of Wind-hover from a very pretty and graceful action with which it hangs suspended in the air, as if by a thread, keeping itself balanced by a constant winnowing of the air by its wings, and from this position it scans the ground below for a stray Mouse which may venture out of its hole, for mice and small birds constitute its principal food. It is frequently to be seen in the autumn hovering about a field of sheaved corn in the twilight, selecting a position about forty feet in the air, and occasionally stooping down on some prey in the stubble below. Should it not succeed in its pounce, it flies a little way in a few easy circles, and again commences to hover over a new part of the field. Insects also form a staple article of food to the Kestrel, who devours them while in full flight, passing its leg up to its bill, and the author has met with an instance of a Kestrel hawking for insects over a stream in the late evening. This Hawk is, unfortunately, often confounded through the ignorance of game-keepers with the Sparrow-Hawk, and suffers consequently for the misdeeds of the latter, a fact much to be regretted, for it is a very useful bird, owing to the number of mice it destroys; indeed, a writer in Macgillivray's "British Birds" computes that a single Kestrel would destroy upwards of ten thousand mice during its stay in Britain. It will also catch birds, but in limited numbers, and then generally only during the breeding season, when its young require constant food. Although of a less ferocious nature and aspect than the Falcons, the Kestrel, nevertheless, often shows forth his accipitrine temperament in a way that would scarcely be expected from his mild-looking dark eye.

* ἱερός, sacred; *falco*, a Falcon; *candicans*, white. † κερχνίς, or κέρχνη, Gr., a Kestrel; *tinnunculus* Lat., a Hawk.

which has nothing of the ferocity of the yellow iris of the Sparrow-Hawk. Some young birds belonging to the writer, consisting of three females and a male, being left without food for a few hours by the person in whose charge they were placed, forgot their fraternal affection, and the larger hen birds set upon the male, who was not so large or strong as they were, and devoured him completely. When shooting in a sandy island near Heligoland also, the writer wounded a Dunlin, which floated on the water a considerable distance out at sea, and whilst waiting for the waves to bring the bird in to land a Kestrel hove in sight and made a swoop at the Dunlin, which the latter avoided by a rapid dive. Twenty-three times the Hawk repeated the manœuvre without success, until the poor little wader became exhausted, and was borne in the talons of his relentless foe towards the rock of Heligoland, about a mile off. This action had been witnessed also by Messrs Seebohm and Nicholson, from other parts of the same sandy island, and the latter kept pace with the Kestrel as it skirted the beach, in the hopes that it might cross the island, when a shot would perhaps have caused the bird to drop his exhausted quarry. The Hawk, however, kept well out at sea, and regained his rocky home, though he was several times seen to pause in his flight and take a tighter grasp of his victim.

COMMON KESTREL.

The nest of the Kestrel is often placed in towers and old buildings, and the bird is sometimes to be seen round the Nelson monument in Trafalgar Square, but a tree is more frequently the site selected, when an old Crow's or Raven's nest is often chosen. The hen bird, as is the case with most Hawks, sits very close, and will often require a stick or stone to be thrown close to the nest before it will move off, and the sudden drop which it gives is often the means of saving its life, as the chance of a successful shot is difficult. The eggs are from four to six in number, and are rather handsomely coloured, being blotched with rufous on a white ground, and are not unfrequently entirely rufous.

In most of the Kestrels the sexes differ conspicuously in colour, the females being barred. This is the case in the common species, where the male has a blue head and tail. In the size of the sexes there is little or no difference, each measuring about twelve inches and a half. In winter, when there are fewer mice and beetles about, the Kestrel shifts his quarters, and becomes to a certain extent migratory: at this season of the year it visits India and Africa, not extending, however, so far down the latter continent as some of the European birds go. It is abundant at certain seasons in north-eastern Africa and Senegambia, but seldom goes as far as the Cape. The most easterly occurrence that is known of the Common Kestrel is the island of Borneo, though it is a common bird in China. It should be mentioned, however, that the Kestrel is always darker in colour from Japan and China, so much so that many naturalists consider it to be a distinct species from the British bird.

OSPREY.

THE SECOND SUB-ORDER.—PANDIONES.

CHAPTER VI.

THE OSPREYS AND OWLS.

THE OSPREY—Distribution—Food—How it Seizes its Prey—Nesting Communities—STRIGES, or OWLS—Distinctions between Hawks and Owls—Owls in Bird-lore and Superstition—Families of the Sub-order—THE FISH OWL—PEL'S FISH OWL—The EAGLE OWL—Dr. Brehm's Description of its Appearance and Habits—THE SNOWY OWL—HAWK OWLS—PIGMY OWLETS—THE SHORT-EARED OWL—THE LONG-EARED OWL—THE BARN OWL—The Farmer's Friend—Peculiar Characters—Distribution.

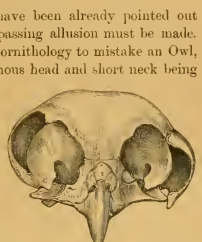
THE OSPREY, OR FISHING EAGLE (*Pandion haliaëtus*).

THE Osprey is one of the most cosmopolitan of the birds of prey, being found all over the world, with the exception of the continent of South America and some of the Pacific Islands. Specimens from Australia and the Moluccas are generally smaller than those from Europe or America; but as the size of the species appears to vary in different localities, the Australian form cannot be considered other than a permanently smaller race. Everywhere the habits of the Osprey seem to be very similar, the bird never being found away from the vicinity of water, unless it be sometimes during the breeding

season, when it makes its nest at some distance from its feeding haunts. Its food consists entirely of fish, and it is capable of carrying off one of considerable size; in the capture of its prey it is greatly aided by its reversible toes, and by the roughness of the sole of the foot, which is covered with minute spikes, and these are, of course, of great assistance to the bird in holding such a strong and slippery prey as a large fish often proves to be. Professor Newton writes of one living in the Zoological Gardens, that "when a fish was given to it, it was observed to seize it across the body, placing the inner and outer toes at right angles with the middle and hind toes, and, digging in the claws, it held the fish most firmly by four opposite points, not relaxing its hold or altering the position of the toes, but picking out the portions of flesh from between them with great dexterity." Occasionally, the Osprey attacks a fish beyond its strength, and it is then drawn under the water, and drowned. Mr. Dresser saw this happen in the Bay of Fundy, when a Fish Hawk was unable to release itself from a heavy fish, and, after being dragged under the water time after time, was ultimately carried out to sea, and disappeared. Mr. Collett, of Christiania, tells us that in one of the Norwegian lakes a huge Pike was caught, with the remains of an Osprey's skeleton still attached to its back. Sometimes, on landing its prey, the bird is unable to extricate its talons, and is captured alive. The nest of the Osprey is a large structure, and is variously situated, according to the nature of the locality. It is generally placed on a tree: but in situations where there are no trees the position chosen is on a large rock or stone, very often on the islands in the middle of the lakes which it frequents. The eggs are generally three in number, sometimes four, and are very beautiful, varying from a rich red to a buffy-white colour, with large reddish and brown markings. In Europe it is found nesting invariably in pairs, but in North America large communities are found; and Dr. Brewer relates that sometimes as many as "three hundred pairs have been observed nesting on one small island; and when a new nest is to be constructed, the whole community has been known to take part in its completion. They are remarkably tolerant towards smaller birds, and permit the Purple Grakle (*Quiscalus purpureus*) to construct its nests in the interstices of their own."

THE THIRD SUB-ORDER.—STRIGES, THE OWLS.

The principal distinctions between Hawks and Owls (*Striges*) have been already pointed out (p. 255); but there are still some other smaller characters to which a passing allusion must be made. It would be difficult, for instance, for the merest novice in the study of ornithology to mistake an Owl, when seen alive in a cage, or even in a case of stuffed birds, its enormous head and short neck being unlike those of any of the other birds of prey. The neck of some Owls is, indeed, so short and contracted, that it is with difficulty that any intervening curve between the nape and the back, which would mark a perceptible neck as in most Hawks, can be detected. Again, the Owls have their eyes directed forwards, so that they confront the spectator; while most of the other birds of prey turn their head more or less on one side when their attention is diverted, and do not look one straight in the face as an Owl does. The cere is almost always hidden by bristles in the *Striges*, and the latter have a very distinct facial disc, surrounded by a curious ruff, somewhat similar to that of the Harriers (*Circus*, p. 268), and Harrier-Hawks (*Micrastur*, p. 270). The external ear-opening is a complicated organ in the Owls, and differs considerably, the orifices often being of different form on either side of the head; and in one species, Tengmalm's Owl (*Nyctala tengmalmi*), the ear-openings are of different shape in the skull itself.



SKULL OF TENGMALM'S OWL.

To those interested in bird-lore, a most entertaining study might be afforded by tracing the superstitions with which Owls have been regarded in all countries, and in the earliest times. Such a study was begun by the late Mr. Broderip, in his "Zoological Recreations,"* where he quotes from the ancient writers many passages, which show that Owls were as much regarded as birds of ill-omen by the inhabitants of Greece and Italy in olden times as they have been in England up to the present

* pp. 82, 95.

day. Nor is the infatuation confined to Europe, as later on are quoted instances of superstitious dread of the Owls in Morocco and West Africa; while they are equally held in fear in many Eastern countries.

The Athenians alone seem to have had a regard for these birds, and an Owl is found on the reverse side of many of their coins, the bird being sacred to their guardian deity, Athené. The species figured is probably the Little Owl (*Carine noctua*), a bird which is common in Greece. It is difficult to guess why the Owl came to be regarded as the embodiment of wisdom, unless it was from its having been sacred to Minerva, the Goddess of Wisdom, who is sometimes represented as the Owl-headed goddess.

"The Owlet's wing," writes Mr. Harting,* "was an ingredient in the cauldron wherein the witches prepared their 'charm of powerful trouble' (*Macbeth*, Act iv., sc. 1); and with the character assigned to it by the ancients, Shakspere, no doubt, felt that the introduction of an Owl in a dreadful scene of a tragedy would help to make the subject come home more forcibly to the people, who had,

LITTLE OWL.

rom early times, associated its presence with melancholy, misfortune, and death. Accordingly, we find the unfortunate Owl stigmatised as the 'obscure,' 'ominous,' 'fearful,' and 'fatal' 'bird of night.' Its doleful cry pierces the ear of Lady Macbeth while the murder is being done :—

> 'Hark! Peace!
> It was the Owl that shriek'd, the fatal bellman,
> Which gives the stern'st good-night.'
>
> *Macbeth*, Act ii., Sc. 2.

And when the murderer rushes in immediately afterwards, exclaiming—'I have done the deed. Didst thou not hear a noise?' She replies—'I heard the Owl scream.' And later on—'The *obscure bird* clamour'd the live-long night.'" (*Macbeth*, Act. ii., Sc. 3.)

The awe, no doubt, with which this bird is regarded by the superstitious, may be attributed in some measure to the fact of its flying by night.

> "Deep night, dark night, the silent of the night,
> . . . . . .
> The time when Screech-Owls cry and Ban-Dogs howl."
>
> *Henry VI.*, Part ii., Act i., Sc. 4.

* Ornithology of Shakspere.

And yet, strange to say, the appearance of an Owl by day is by some considered equally ominous :—

"The Owl by day,
If he arise, is mocked and wondered at."
Henry VI., Part iii., Act v., Sc. 4.

"For Night-Owls shriek, where mounting Larks should sing."
Richard II., Act iii., Sc. 3.

Should an Owl appear at a birth, it is said to forebode ill-luck to the infant. King Henry VI. addressing Gloster, says :—

"The Owl shrieked at thy birth, an evil sign."
Henry VI., Part iii., Act v., Sc. 6.

While upon any other occasion, its presence was supposed to predict a death, or at least some dire mishap :—

"The Screech Owl, screeching loud,
Puts the wretch that lies in woe
In remembrance of a shroud."
Midsummer Night's Dream, Act v., Sc. 2.

When Richard III. is irritated by the ill-news showered thick upon him, he interrupts the third messenger with

"Out on ye, Owls! Nothing but songs of death?"
Richard III., Act iv., Sc. 4.

The same author, from whom the above Shaksperian illustrations are quoted, alludes further to the superstitious dread of the Owl, which exists likewise amongst the Dyaks of Borneo, and in Ceylon a Wood-Owl, belonging to the same genus *Syrnium*, to which the English Wood-Owl belongs, is known as the "Devil-bird," and is held in great fear. Colonel Irby, writing of the Barn-Owl,* tells the following story from the MS. of the late Mr. Favier, of Tangier :—"The inhabitants of Tangier consider this bird the clairvoyant friend of the Devil. The Jews believe that their cry causes the death of young children; so in order to prevent this, they pour a vessel of water out into the courtyard every time that they hear the cry of one of these Owls passing over their house. The Arabs believe even more than the Jews, for they think that they can cause all kinds of evil to old as well as young; but their mode of action is even more simple than that of their antagonists the Jews, as they rest contented with cursing them whenever they hear their cry. Endeavouring to find out from the Mahometans what foundation there is for the evil reputation of this species, I was told this: 'When these birds cry they are only cursing in their own language; but their malediction is harmless unless they know the name of the individual to whom they wish evil, or unless they have the malignity to point out that person when passing him; as the Devil sleeps but little, when there is evil work to be done he would infallibly execute the command of his favourite if one did not, by cursing the Owl by name, thus guard against the power of that enemy, who is sworn to do evil to all living beings.' Having learned the belief of the Mahometans relative to this Owl, it was more difficult to find out exactly that of the Jews, who, when questioned by me, knew not how to answer, except that the act of pouring water in the middle of the courtyard is a custom of long standing, in order to avert the evil which the Owl is capable of doing; that is to say, the water is poured out with the view of attracting the evil spirit's attention to an object which distracts him, and so hides from him the infant which the Owl in its wickedness wishes to show him."

The late Mr. Waterton, in an entertaining essay on the habits of the Barn-Owl, says :—"Among the numberless verses which might be quoted against the family of the Owl, I only know of one little ode which expresses any pity for it :—

'Once I was a Monarch's daughter,
And sat on a lady's knee;
But am now a nightly rover,
Banish'd to the ivy tree.

* "Ornithology of the Strait of Gibraltar," &c., p. 56.

Crying, hoo, hoo, hoo, hoo, hoo, hoo.
Hoo, hoo, hoo, my feet are cold;
Pity me, for here you see me,
Persecuted, poor, and old.'" *

The Owls are divided into two families, the first of which is called *Bubonidæ*, and the second *Strigidæ*. In the latter family are represented only two genera, *Strix* and *Heliodilus*, which contain six species, all the remaining Owls, about one hundred and ninety in number, belonging to the *Bubonidæ*. The breast-bone in the latter family always shows two or more clefts or indentations, and there are no "serrations" on the middle claw, whereas the Barn-Owls always have the inner edge of the middle claw serrated, that is, with a small, toothed margin, like the teeth of a saw (*serra*, Lat., a saw; *serratus*, notched like a saw), and the breast-bone has no clefts in its hinder edge. The *Bubonidæ* embrace two sub-families, the *Bubonina*, which have no *operculum*, or fold of skin, closing in the ear, and the *Syrniina*, which have a very large *operculum*. It seems natural to commence the classification of the Nocturnal Accipitres with the Bare-legged or Fishing Owls, as the structure of this part very much resembles that of the Osprey, which was the concluding representative of the Diurnal Accipitres. The thigh feathers are thick, and fit close to the leg; the tarsus and toes are bare; the outer toe is reversible; and the soles of the feet are covered with tiny spicules, which serve to hold fast their finny prey in the same manner as do those of the Osprey.

THE FISH OWL.

The following account of the Indian Fish Owl (*Ketupa* † *ceylonensis*) is taken from the work by Captain Vincent Legge, R.A., on the birds of Ceylon:—"This large Owl loves the vicinity of water, haunting the banks of rivers, tanks, inland salt lagoons, the borders of sea-bogs, and woods surrounding rice-fields. All who have visited the tanks in the north and east of Ceylon must be familiar with the fine bird, which so often is surprised napping in the lofty trees growing on the embankments, or so-called 'bunds.' Its powers of vision in the day are not quick, but they are tolerably clear. On hearing the footsteps of man, it raises its large ear-tufts, and bending down its head, stares steadily down from its lofty perch among the green boughs, and as soon as it becomes aware of the nature of the intruder on its retreat, launches itself out of the tree, and is not easily approached a second time. It is much more common in wild forest country, combined with water, than in cultivated districts. It sallies out in the evening with great regularity. As soon as the sun begins to sink behind the surrounding forest, it may be noticed flapping noiselessly round some secluded cheena, or leisurely crossing the lonely tank, resounding at the hour of sunset with the buzzing of innumerable frogs, to the nearest conspicuous tree, and there gives out its sepulchral groan. This gloomy salutation is usually responded to by its mate, who perches close at hand, and answers by a double note, the two lonesome sounds resembling the words *gloom—oh, gloom*. At night I have often heard these notes repeated by a pair without intermission for many minutes. Layard remarks that, when alarmed during the day, they utter a loud hiss, subsiding into a growl. They appear to have an accustomed place of roosting, for Mr. Houldsworth notices that they 'perched day after day on the same branch.' This is very often in an exposed situation, and it frequently falls to their lot to be mobbed by a flock of garrulous Bulbuls, King-Crows, and other Owl-hating small birds. Fish is the favourite food, and, in fact, the usual diet of this species; but when this is not procurable, small mammals, reptiles, and even insects are devoured by them. In the stomach of one, for example, I found a Snake (*Haplocercus ceylonensis*), and some large Beetles. As a proof of their miscellaneous diet, and also of their voracity, I may mention that a pair of Fish Owls, which were kept by Sir Charles Layard in the same aviary with a Brahmin Kite, fell one night upon their luckless companion, and, after slaughtering him, forthwith proceeded to devour him completely. Further, Mr. Hume records, in 'Nests and Eggs,' finding the remains of Quails, Doves, and Mynahs in the nest of a pair on the Jumna. It has also been stated that they feed on the carcases of the Gavial and Crocodile."

* "Essays on Natural History," p. 8.

† *Ketupa*, a "barbarous" name, with no meaning.

PEL'S FISH-OWL (*Scotopelia peli*).*

The African Fish-Owls are exactly like the Indian as regards their bare legs, but they have no tufts on their heads. Three different kinds are known, and they are all rare birds, frequenting the rivers and inland lakes of the African continent. Pel's Fish-Owl was discovered on the Gold Coast by Mr. Pel, the Dutch commandant at Elmina, nearly forty years ago. The specimen procured by that gentleman flew across the river Boutry, and settled among some shady boughs on the other bank, when it was knocked down with the blow of a gun. The following account of one of these rare birds, from the Barra country, Senegambia, is given by Mr. John Henry Gurney, who had the specimen alive in his possession for a long time: it was presented to him by Colonel O'Connor, C.B., who is the author of the accompanying "Sketch of Nero, the Owl, a Fetish Bird." The colonel writes †:—"During seven years' exploration of Western Africa, I only met one of the species of the Owl 'Nero.' He was brought 'a chicken,' full of pen-feathers, or rather down, of a delicate straw-colour, and very thick, from a lagoon in the Barra country. No native would admit 'Nero' as a visitor; and when the bird was installed in Government House, the servants and head people came in a body to remonstrate, asserting 'he was a Gumbi Owl, a Fetish!!' and would destroy and kill whatever object he looked on.' The chief groom (an old soldier, who had charge of the poultry) insisted that 'every cock and hen would go dead.' Strangely enough, an epidemic broke out, and carried off from fifty to sixty head of fowls; and each day the groom placed the defunct birds on the steps of Government House, to meet the eye of Mrs. O'Connor, seeming to exult in the mortality amongst the feathered tribe. 'You see wid your own eye, Missus, dat debil Jumbi bird, he go kill all de fowls. Governor tink he hab long head, but he no sabey Owl. Suppose you put him in de stable, he see Nelly (Mrs. O'Connor's favourite mare), de horse he go tumble down dead.' Death at last ceased to reign amongst the poultry population, and Nero became my principal pet; he ranged over the piazza, perching on the branch of a tree; he was fed regularly by the orderly on roasted fish, but he often came to the dinner-table, and flew down for scraps of meat, bread and butter, which he took gently from myself or from Mrs. O'Connor, permitting us to rub his head, crest, neck, and back, seemingly enjoying the caressing. But he would snatch meat or bones from the Cat or Dog; and when the Eagle was introduced into his company, he beat him in a most unmerciful manner away from his peculiar and original position of the piazza, the Eagle being one of the fiercest and most pugnacious of African birds, brought from the upper part of the Gambia river near 'Wallie,' and, when in vigour, able to carry away a kid or small lamb. Nero luxuriated in a tub of water, frequently washing himself, and perching on the rim until dry. He was wont to go out to the garden or fields, where instantly an immense commotion arose among all the birds. The larger ones flew round the Owl, keeping a very civil distance, the smaller birds flew away; but Nero treated both alike with sovereign contempt. He would return of his own accord to the roosting-place in the piazza, and when put out and confined for some days, rejected all food, and pined until restored to his perch. With me he was as tame as any Canary, and, after an absence of two months, recognised my voice when I went to his cage at Oatlands (Devon), appearing much pleased by my taking him out for a walk on the grass. Many natives from the interior told me 'they had never seen such a bird before; but they considered him *unlucky*.' I really think Nero is nearly *sans* any relations, and certainly devoid of all friends in Western Africa."

Pel's Owl measures nearly two feet in length, and has the wing sixteen inches and a half. Its colour is a deep rufous bay, with black transverse bars; below it is light bay, with heart-shaped bars of black; the iris is dark-brown, whereas in the Indian Fishing Owls it is always yellow.

THE EAGLE OWL (*Bubo ignavus*).‡

This and its relative, the Virginian Eared Owl of America, are the largest of all the family. It is found all over Europe and Siberia, extending even to China and the Himalayas, but the few instances of its capture in Great Britain have been probably those of birds escaped from confinement, as it is by no means an uncommon species in aviaries in England. As it is not, strictly speaking,

* σκότος, darkness; πέλεια, a Dove, with a covert allusion to the name of the discoverer (Sclater). † Ibis, 1859, p. 47.

‡ *Bubo*, a Horned Owl (Vergil); *ignavus*, dastardly—an inappropriate title for so fine a bird.

a British bird, recourse must be had to the writings of Continental naturalists for an account of its habits, and the following extract is made from Dr. Brehm's "Bird Life" (p. 567) :—"The Eagle Owl is somewhat fantastic in appearance, usually sitting with its feathers so much ruffled as to make it seem much larger than it really is. 'In that large, shapeless mass of feathers,' says Naumann, 'one can scarcely distinguish the limbs; the half-closed eyes hide their glorious rays; suddenly it opens them wide, bends the head and upper part of the body forwards, swaying from side to side, and raising first one foot and then the other, begins to tremble, winks slowly with the eyelids, spits like a cat, and snaps its bill. When angry its eyes flash fire, it bends forward with hanging wings, ruffles its plumage as much as possible, and snapping and hissing, dashes furiously at the enemy.'

"This bird seems less courageous than surly and quarrelsome, and yet it is asserted that it will fight to the death with the Golden Eagle, when attacked by the latter. The Eagle Owl is a powerful bird, and as there are no bounds to its fury, it is but rarely that anything escapes from its grasp. Though strictly nocturnal in its habits, it always keeps a good look out for its own safety in the daytime, and is ever shy and cautious. Keen of sight and hearing, it takes wing while the danger is still far off. Like other Owls, this bird is fond of pressing itself against the stem of a tree, with unruffled feathers, so as to closely imitate the stump of a tree, and thus escape detection. Inasmuch as deep clefts in the rocks, or the thickest of trees, are its usual retreats, the Owl is often passed over, which fact is undoubtedly an advantage, for the day birds mob it whenever they see it. They may possibly have made it the savage, spiteful bird it is, inasmuch as their system of constant irritation would be sufficient to try the temper of the mildest individual. Thus nothing remains for the Owl but to evade its disturbers, and hide itself as long as possible; but woe betide it if discovered, for then the friends of daylight treat it to a 'charivari' without equal.

"The first to arrive on the scene is the ubiquitous Crow, conducted thither by some inquisitive warbler who has discovered the enemy's retreat. The Crow thoroughly understands what the little fellow means, and hastens to convince itself of the truth of the information. Having satisfied itself, it retires noiselessly, but only to carry the news to its relatives. Now they flock in from all sides to take part in the fight, with an eagerness worthy of the boldest man; greeting one another with hoarse and scornful croaks, the sooty tribe hasten as fast as they can to the scene of action. The mockers surround the poor old 'Grand Duke,' at first at a respectful distance, though they are fully determined effectively to disturb its siesta. There sits the Owl, rolling its eyes, spitting, snapping its beak, and ruffling its feathers, now hopping from one leg to another, now raising and lowering its feathered horns by turns; mad with rage, bemoaning its fate, and at loggerheads with the whole world, it awaits the turn that matters may take; at the same time, be it remembered, every Crow takes good care not to lay hold of the irritated gentleman; nothing less than a Raven dares to rely on its own strength. One of these, however, will run a tilt at the dark knight, using its sharp beak as a lance; but before the latter has time to raise the terrible claw, the Raven makes good its retreat, prepares for another rush, and darts like an arrow, so as to use its weapon effectively. The Owl now loses the last remnant of patience, and seeks safety in flight. Oh, unlucky wight! this is all the black swarm have been waiting for, the Crows being far its superiors on the wing. Giving vent to exulting cries, they dart down from above with such unerring aim and force as to scatter the poor brute's feathers in clouds to the wind: they rise again with a mighty noise that heeds no secrecy, as though they sought to proclaim to the world at large all the fell deeds committed by this Prince of Darkness, while other knights advance to battle. All Hawks and Falcons, ay, the proud Eagle even, answer to the call, and hasten to take part in the fray. Now the Owl must, perforce, either beat a hasty retreat or remain on the field. In any case, however, the Owl is thoroughly worried, and sometimes really damaged, before it finds refuge in some thick tree or rocky cleft, where it hides itself as closely and as silently as its rage will permit, until quit of the Crows.

"The detestation in which the Eagle Owl is held by all diurnal birds is not ill-founded, for this bird preys on every living creature it can overcome, assassinating them in the most abominable manner while they are asleep. Its quarry is as follows:—Fawns of the Roe Deer, Hares, Rabbits, Hamsters, Rats, Moles, Mice, Capercailzie, Black-game, Hazel-hens, Pheasants, Partridges, Rooks, Jays, Magpies, Snakes, Lizards, and Frogs: Rooks seem to be its favourite morsel. No wonder, then, that they pay their enemy out if they can only see an opportunity. It assassinates them; they

attack it in open day. The Eagle Owl generally breaks the spine of the smaller animals close to the head, and, cracking the remaining bones, devours its prey, skin and all; the heads of the larger birds it pulls in large pieces which it swallows. It, however, always devours a portion of the hair, feathers, or scales as well, and wastes away if fed on flesh alone. The indigestible portions of the meal are thrown up in large round pellets or 'casts.' With larger animals, it lays open the skin of the belly, and eats out the flesh from inside. If it finds that there is too much for one meal, it carefully replaces the skin, and hides the remainder in some dark cranny or corner until required again. This Owl

SNOWY OWL.

drinks rarely, slaking its thirst generally with the blood of its victims. If food is plentiful, it gorges itself; but in times of dearth it can go without food for weeks together.

"By the last fortnight in March the Eagle Owls commence preparations for breeding. At this season may be heard their hollow, muffled cry of 'poohoo, poohoo,' which is distinguishable at a great distance through the woods, and it is not to be wondered that the timid are frightened at it. In the silent, dark recesses of the mountain forest a variety of noises, well calculated to make one's flesh creep, fall upon the ear: the shrill, mocking laugh, a sound as of snarling hounds; the whoop of the hunter, the snorting of Horses; these are all calculated to impress the uneducated and superstitious with the truth of the legend of the wild huntsman. Even to the ear of the better-informed, these hideous cries, the loud screech of the female, or the 'poohoo' of the male, intermingled with the snapping of the beak and curious miaulings, sound somewhat weird; and the boldest of mortals can

scarcely repress a cold shudder when a company of these forest spirits favour him with one of their demoniacal nocturnal concerts. Doubtless these sounds represent the battle-cries of the males when fighting for the females, and take the place of the song of the Nightingale when telling its tale of love.

"After the Owls have paired these cries are heard less frequently, both birds being now fully occupied with their nursery operations. The large nest is composed outwardly of branches and sticks, and is lined with dry leaves and small twigs. It is built, and generally placed in either the cleft of a rock or in a hole in some ruined tower; the nest is never built in a tree but from necessity. The two or three eggs are also often found lying on the bare surface of the rock, without any nest whatever. They are round, cross-grained, and white, and somewhat larger than a hen's egg. The young are hatched in about three weeks. They are usually two in number, rarely three; they look, on their first appearance, like balls of cotton-wool, and keep up a constant hissing or shrill whistle. They remain a long time in the nest, and are so abundantly provided with food by the parent birds, that one is sure to find a large heap of provisions at the nest. The Owlets often betray their presence to their innumerable enemies by their cries, and suffer much persecution in consequence. When about eight weeks old they are able to fly, though they still remain for some time longer under the care of the old birds. These latter rarely wander far from a particular neighbourhood, and usually build in the very same place the following year."

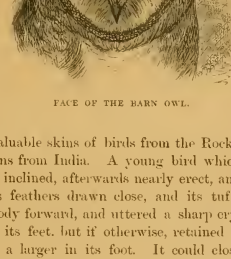
SHORT-EARED OWL.

Besides the Eagle Owls, the sub-family *Bubonidæ* contains the Snowy Owl (*Nyctea* scandiaca*†), all the Hawk Owls (*Surnia*‡ *Ninox*§), and the Pigmy Owlets (*Glaucidium*‖). Many of the birds belonging to this latter genus are not much bigger than a Sparrow. They are found nearly all over the world, with the exception of Australia and Oceania, and one species, the European Pigmy Owlet

* νύκτιος, nightly, *i.e.*, a bird of night—a most inappropriate title for the Snowy Owl, which is a day-flier.
† *Scandiaca*, Scandinavian. ‡ A proper name. § A "barbarous" name, of no meaning.
‖ From γλαυκός, blue or grey.

(*G. passerinum**), is by no means uncommon in many parts of the Continent, though it has not yet been met with for certain in the British Islands.

The sub-family *Syrniinæ* contains only three genera, the Horned Owls (*Asio*†), the Wood Owls (*Syrnium*‡), and the Tengmalm's Owl (*Nyctala*§ *tengmalmi*), the latter having been already noticed (p. 297) as possessing the curious difference in the ear-opening on each side of the skull. Of the Horned Owls two species are found in the British Islands, viz., the Short-eared Owl (*Asio accipitrinus*‖), and the Long-eared Owl (*A. otus*¶). The former of these birds is often seen in the daytime, and is said to hunt for its prey on dull days, when it will fly at small birds as well as mice; and Mr. Low, writing on the birds of the Orkneys, where the Short-eared Owl breeds, says that he has found in the nest the remains of a Moor-fowl (Red Grouse), two Plovers, besides the feet of several others; and the same writer states that during the breeding season it becomes very impudent, and will even seize and catch up chickens from the doors, and also chase pigeons in open daylight. Although resident in the British Islands, a large migration of the species takes place in autumn, and it is not unfrequently shot by sportsmen in the turnip-fields; while Bewick mentions the recurrence of twenty-eight individuals being flushed in a turnip-field in November, being probably attracted to the locality by an abundance of food. It may also be occasionally found in marshes near the sea-shore, as occurred once to the writer, who started a Short-eared Owl from the sedgy bank on the west side of Pagham Harbour, in the early part of September. When winged, it boldly faced its pursuer, erecting the little tufts on its head and fiercely snapping its bill, as is the manner with all Owls in defending themselves.



FACE OF THE BARN OWL.

Its relation, the Long-eared Owl, is a bird of different habits, and, instead of breeding on the ground as the foregoing species does, it selects a dark wood or clump of firs, appropriating a deserted Squirrel's "dray," or adapting the nest of another bird to its own requirements. Macgillivray gives the following account of a young specimen which he had in confinement:—"An individual of this species, which was sent to me in winter by the Rev. Mr. Adam, having been left at night perched on the back of a chair in my drawing-room, tore to tatters six valuable skins of birds from the Rocky Mountains, and an equal number of nearly equally rare specimens from India. A young bird which I kept for some time, on perching, stood at first with the body inclined, afterwards nearly erect, and slept in the latter posture, with its neck rather extended, its feathers drawn close, and its tufts recumbent. When irritated, it raised its plumage, threw its body forward, and uttered a sharp cry. It seized its food with its bill; if large, transferred it to one of its feet, but if otherwise, retained it in its bill. In flying, it carried a small object in its bill, but a larger in its foot. It could close one eye while the other remained open, and when placed in a strong light, frequently drew the membrane over the lighted eye, while the other remained unsheathed, though for the most part it winked with both simultaneously. The irides contracted unequally, according to the degree of light. When perched at night, it sometimes emitted a clicking noise, like that of a spring, with its bill; but when provoked, it neither hissed nor snapped, but uttered a shrill, tremulous, plaintive cry, or succession of short notes, erecting its tufts at the same time."

THE BARN OWL (*Strix* ** *flammea* ††).

This is essentially the friend of man, frequenting villages and homesteads where he is protected, and extending his range where civilisation precedes him, being attracted doubtless by the Mice and Rats, which are also the accompaniments of civilisation. The number of small mammals which one of these birds will devour ought to be his passport to the protecting care of the farmer and agriculturist,

* Passerine, or Sparrow-like: *i.e.*, of the size of a Sparrow. † A proper name. ‡ Σκῶπος, a proper name.
§ νυκτελὸς, nocturnal. ‖ Like a Hawk. ¶ Ἄσιος, long-eared Owl. ** στρυγξ, an Owl.
†† Fiery; flame-coloured.

but it is seldom that an Owl of any kind meets with approval on taking up his residence on an estate. Facts, however, are stubborn things, and in the hope that a more generous reception may be afforded to these useful birds, the following quotation is made from Professor Newton :—"Owls, like other birds of prey, as already mentioned, return by the mouth the indigestible parts of the food swallowed in the form of elongated pellets. These are found in considerable numbers about the usual haunts of the birds, and examination of them reveals the nature of the food, and shows in nearly every case the great services they render to man by the destruction of Rats and Mice."* The infallibility of the evidence thus afforded as to the food of the Owls is as complete as the way of obtaining it, by those who have the opportunity, is simple. Several German naturalists have made some very precise researches on this subject. The following results, with regard to the three commonest species of Owls, are those afforded by the investigations of Dr. Altum, as communicated by him to the German Ornithologists' Society during its meeting in 1862 :—

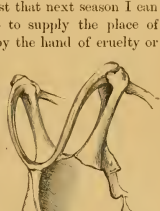
	Remains Found.							
	No. of Pellets examined.	Rats.	Rats.	Mice.	Voles.	Shrews.	Moles.	Birds.	Beetles.
Tawny Owl . .	210	—	6	42	296	33	48	18	48
Long-eared Owl . .	25	—	—	6	35	—	—	2	—
Barn Owl . . .	706	16	3	237	693	1,590	—	22	—

Colonel Irby, in the work which has already been alluded to, says of the Barn Owl :—"Almost exclusively feeding on Rats and Mice, they deserve every encouragement and support that can be afforded them; but from being in all countries regarded with superstitious awe and dislike, they are more or less persecuted on that account; and in England, through the ignorance and stupidity of gamekeepers, who fancy that they kill game (*i.e.*, feathered game), they suffer most severely. This excuse is ridiculous, for old birds they have not the power to kill, and young Pheasants and Partridges, at the time the Owls are on the feed, are safely being brooded by the parent bird." Those who wish to encourage and increase Owls, and have not hollow trees or buildings where they nest, may always gratify their wishes by fixing an empty barrel (about an 18-gallon size) horizontally in the fork of any large tree, cutting a hole in one end large enough for the birds to enter; but the hoops of the cask should be screwed on, or it will soon fall to pieces. Not only the Barn Owl, but the Tawny Owl (*Syrnium aluco*) also will use barrels, or "Owl-tubs." The difficulty, however, is to keep out the Jackdaws, but when once the Owls have established themselves, there is no fear of that intrusion. The late Mr. Waterton was a well-known admirer of the present species, and he devotes one of his "Essays on Natural History" to the Barn Owl, from which a few passages are extracted :—"Up to the year 1813 the Barn Owl had a sad time of it at Walton Hall. Its supposed mournful notes alarmed the aged housekeeper. She knew full well what sorrow it had brought into other houses when she was a young woman, and there was enough of mischief in the midnight wintry blast, without having it increased by the dismal screams of something which people knew very little about, and which everybody said was far too busy in the churchyard at night-time. Nay, it was a well-known fact, that if any person were sick in the neighbourhood it would be for ever looking in at the window, and holding a conversation outside with somebody, they did not know whom. The gamekeeper agreed with her in everything she said on this important subject, and he always stood better in her books when he had managed to shoot a bird of this bad and mischievous family. However, in 1813, on my return from the wilds of Guiana, having suffered myself, and learned mercy, I broke in pieces the code of penal laws which the knavery of the gamekeeper and the lamentable ignorance of the other servants had hitherto put in force, far too successfully, to thin the numbers of this poor, harmless, unsuspecting tribe. On the ruin of the old gateway, against which tradition says the waves of the lake have dashed for the greater part of a

* Newton's edition of Yarrell's "British Birds," Vol I., p. 147.

thousand years, I made a place with stone and mortar, about four feet square, and fixed a thick oaken stick firmly into it. Huge masses of ivy now quite cover it. In about a month or so after it was finished a pair of Barn Owls came and took up their abode in it. I threatened to strangle the keeper if ever, after this, he molested either the old birds or their young ones; and I assured the housekeeper that I would take upon myself the whole responsibility of all the sickness, woe, and sorrow that the new tenants might bring to the Hall. She made a low courtesy, as much as to say, 'Sir, I fall into your will and pleasure,' but I saw in her eye that she had made up her mind to have to do with things of fearful and portentous shape, and to hear many a midnight wailing in the neighbouring woods. I do not think that up to the day of this old lady's death, which took place in her eighty-fourth year, she ever looked with pleasure or contentment on the Barn Owl, as it flew round the large sycamore trees which grow near the ruined gateway.

"When I found that this first settlement on the gateway had succeeded so well, I set about forming other establishments. This year I have had four broods, and I trust that next season I can calculate on having nine. This will be a pretty increase, and it will help to supply the place of those which in this neighbourhood are still unfortunately doomed to death by the hand of cruelty or superstition. We can now always have a peep at the Owls in their habitation on the old ruined gateway whenever we choose. Confident of protection, these pretty birds betray no fear when the stranger mounts up to their place of abode. I would here venture a surmise that the Barn Owl sleeps standing. Whenever we go to look at it we invariably see it upon the perch, bolt upright, and often with its eyes closed, apparently fast asleep. Buffon and Bewick err, no doubt unintentionally, when they say that the Barn Owl snores during its repose. What they took for snoring was the cry of the young birds for food. I had fully satisfied myself on this score some years ago. However, in December, 1823, I was much astonished to hear this same snoring kind of noise, which had been so common in the month of July. On ascending the ruin, I found a brood of young Owls in the apartment.



BREAST-BONE OF THE BARN OWL.

"Upon this ruin is placed a perch, about a foot from the hole at which the Owls enter. Sometimes, at mid-day, when the weather is gloomy, you may see an Owl upon it, apparently enjoying the refreshing diurnal breeze. This year (1831) a pair of Barn Owls hatched their young, on the 7th of September, in a sycamore tree, near the old ruined gateway.

"If this useful bird caught its food by day, instead of hunting for it by night, mankind would have ocular demonstration of its utility in thinning the country of Mice; and it would be protected and encouraged everywhere. It would be with us what the Ibis was to the Egyptians. When it has young, it will bring a Mouse to the nest about every twelve or fifteen minutes. But in order to have a proper idea of the enormous quantity of Mice which this bird destroys, we must examine the pellets which it ejects from its stomach in the place of its retreat. Every pellet contains from four to seven skeletons of Mice. In sixteen months from the time that the apartment of the Owl on the old gateway was cleaned out, there has been a deposit of above a bushel of pellets. The Barn Owl sometimes carries off Rats. One evening I was sitting under a shed, and killed a very large Rat as it was coming out of a hole about ten yards from where I was watching it. I did not go to take it up, hoping to get another shot. As it lay there, a Barn Owl pounced upon it, and flew away with it. This bird has been known to catch fish. Some years ago, on a fine evening in the month of July, long before it was dark, as I was standing on the middle of the bridge, and minuting the Owl by my watch as she brought Mice into her nest, all on a sudden she dropped perpendicularly into the water. Thinking she had fallen down in epilepsy, my first thoughts were to go and fetch the boat; but before I had well got to the end of the bridge, I saw the Owl rise out of the water with a fish in her claws, and take it to the nest. When farmers complain that the Barn Owl destroys the eggs of their Pigeons, they lay the saddle on the wrong horse; they ought to put it on the Rat. Formerly, I could get very few young Pigeons, till the Rats were excluded effectually from the dovecot. Since that took place it has produced a great abundance every year, though the Barn Owls frequent it, and are

encouraged all around it. The Barn Owl merely resorts to it for the purpose of concealment. If it were really an enemy to the dovecot, we should see the Pigeons in commotion as soon as it begins its evening flight; but the Pigeons heed it not. Whereas, if the Sparrow-Hawk or Hobby should make its appearance, the whole community would be up at once; proof sufficient that the Barn Owl is not looked upon as a bad, or even a suspicious character, by the inhabitants of the dovecot."

The colour of the Barn Owl, which is a bright orange buff, mottled with ashy-grey on the upper surface, and white below, distinguishes it from any other Owl. The oval form of the disc is also to a great extent peculiar, as is also the serrated edge to the middle claw, which has been referred to before (p. 300). The breast bone is likewise remarkable, as it has no clefts in the hinder margin.

The range of the present species is very considerable, as it is found all over the New World, from the northern and middle United States down to Patagonia and the Falkland Islands. In the Old World it occurs in equal plenty, but does not extend very high north, being a rare visitant to Denmark and Sweden. Although common in Poland, it is only sparingly distributed throughout Russia, and even appears to be entirely absent in many Central and Southern parts. The same may be said of Turkey. It is not known at present from Siberia or China, but is found throughout Africa, India, Australia, and the majority of the Oceanic Islands. Nearly all Owls have two distinct phases of plumage—a grey one, and a red one. This is especially the case in the little Scops Owls, which have tufts of feathers on the head like the Eagle Owls, of which they may be said to be representations in miniature. The Barn Owls are no exception to this general rule of the family; but owing to the light colouring of the bird, it is not so perceptible as in some of the other species of Owls. Even in England, however, a short study of the species will show the student that some individuals are much redder underneath, instead of being white, and are profusely freckled with grey above; and this dark coloration does not depend upon the age of the bird, nor is it a difference of sex. In some islands, such as the Cape Verde group, San Domingo in the West Indies, the Falkland Islands, and the Galapagos, the Barn Owls are almost always dark-coloured, and light ones are very seldom found. On the other hand, in Australia and Oceania the species becomes peculiarly light in plumage, and dark individuals are the exception.

THE SECOND ORDER.—PICARIAN BIRDS (*Picariæ*).*

CHAPTER VII.

THE PARROTS.

Characteristics of the Order—The Sub-orders—ZYGODACTYLÆ—The Parrots—Their Talking Powers—Sections of the Family—The Great Palm Cockatoo—The Pygmy Parrots—The Amazon Parrots—The Amazons—The Grey Parrot—Court Favourites—Historical Specimens—In a State of Nature—Mr. Keulemans' Observations—The Conures—The Rose-ringed Parrakeet—Known to the Ancients—Habitat—Habits—The Carolina Conure—Destructive Propensities—The Parrakeets—The Owl Parrot—Chiefly Nocturnal—Incapable of Flight—How this Fact may be accounted for—Dr. Haast's Account of its Habits—The Straight-billed Parrots—The Brush-tongued Parrots—The Nestors—The Kaka Parrot—Skull of a Parrot—The Bill.

The birds which are contained in this order are of very different forms, but they possess one character which, although an osteological one, is found throughout nearly the whole group, and that is, the double notch in the hinder margin of the sternum or breast bone. In all the true *Passeres*, or perching birds, only a single notch is observed. The hind toe, which in the true perching birds is an essential character, and is separately movable, possessing its own distinct flexor muscle, is in the Picarians not of so much account, its flexor muscle being joined to the common flexor of all the toes; it is sometimes absent altogether. If the Parrots have certain characters in common with the *Accipitres*, the Cuckoos and the Plantain-eaters undoubtedly show affinity to the Game-birds, while most of the other families have peculiar structures which render them quite distinct from the ordinary mass of true perching birds or Passeres. It may be remarked that the eggs of most of the *Picariæ*, so far as we are acquainted with them, are glossy white, and that the majority of them breed in the holes of trees or of

* From *Picus*, a Woodpecker.

COCKATOOS.

rocks, and that they are as a rule bad nest-builders. The greatest exception to the above description of the nesting of these birds is met with in the family of Goatsuckers (*Caprimulgidæ*), some of whom lay their eggs on the ground, the eggs being beautifully marbled with streaks and spots.

Within this great Picarian order there are two large sub-orders, called respectively the Scansorial and the Fissirostral* *Picariæ*. The Scansorial birds are also sometimes known as the Zygodactylæ,† or yoke-footed birds, because they have their toes arranged in pairs, two in front and two behind, and their name of Scansores is given to them because most of them are climbing birds, and run up trees and rocks with great facility, though in different ways. Parrots, for instance, use their bills in climbing from branch to branch, while Woodpeckers have very powerful feet and stiffened tail-feathers, which support them as they cling to the bark of the trees, the bill being chiefly employed to prise off the bark in order to get at the insects underneath. Cuckoos do not climb trees in the same manner as the Woodpeckers, though they have true zygodactyle feet: the present writer has, however, seen a common Cuckoo (*Cuculus canorus*) cling with both feet to the trunk of a huge elm while it picked off insects from the bark. It must not be supposed, however, that the above are the only birds which climb trees, for among the true Passeres, or perching birds, there occur such birds as the *Dendrocolaptidæ* in South America, who have stiffened tails exactly as the Woodpeckers, while the Tree-creepers are just as expert as the last-named birds, and yet cannot be placed in the same order as the Scansorial (*Picariæ*), for they possess a simple passerine foot, with three toes in front and one behind.

The Fissirostres, or wide-gaping birds, are also called Gressorial Picariæ, as their toes are more or less connected together, which gives them a very flat sole to the foot. They generally hunt for their food from some selected spot, ordinarily a post or a dead bough, whence they take flights after their prey, usually returning to the same spot to devour it. Their flight is active and swift, their gape extremely large, and the head correspondingly big, and in many instances clumsy and ungainly. The feet are generally small and weak.

SUB-ORDER I.—ZYGODACTYLÆ.

FAMILY I.—THE PARROTS (*Psittaci*).

Just as the Monkeys have been placed at the head of the Mammalia on account of their high development, so the Parrots, from their general cleverness, and especially on account of the facility with which they can talk, have been considered the highest order of birds, and placed at the beginning of the class. It is impossible for some people to avoid the conclusion that these birds think and reason, and the *à propos* or sometimes *mal à propos* way in which they introduce speeches, coupled with the look of wisdom which they assume while being spoken to, seems to show that the brain is being employed in thinking. A friend in Manchester told the writer of a parrot-show in the North of England, where the talking powers of each bird were made the subject of a prize competition. Several of the birds had exhibited their prowess, and at last the cover was removed from the cage of a Grey Parrot, who at once exclaimed, on seeing the company to which he was suddenly introduced, "By Jove! what a lot of Parrots!" an observation which gained him the prize at once. Instances of famous talking birds might be multiplied by the hundred, and it is wonderful to read some of the stories which have been related of Parrots, whose fame has been recorded in many popular works, leaving no doubt that these birds often possess the power of reason of a very high order; at the same time, it must be confessed that many of the Corvine birds, such as Ravens, Jackdaws, and Magpies, do not fall far short of their Scansorial friends.

The Parrots are divided into two large sections, firstly the Parrots proper (*Psittaci proprii*), and secondly the straight-billed Parrots (*Psittaci orthognathi*‡). These two sections together contain six families, of which five belong to the first and one to the second. The true Parrots have a powerful and swollen bill, especially as regards the lower mandible, which is much inflated, curved, and flattened in front, the cutting edges (*tomium*) indented just behind their tip. The sub-family which has to be noticed first are the *Camptolophinæ*§ or Cockatoos, which are birds entirely of the Australian

* *Fissus*, cleft; *rostrum*, a beak.

† ζυγόν, a yoke; δάκτυλος, a toe.

‡ ὀρθός, straight; γνάθος, a jaw.

§ κάμπτω, to bend; λόφος, a crest.

region, being confined to Australia and the Moluccas Islands. The bill is higher than it is broad, with a very distinct indentation of each side of the cutting edge of the mandible, the tip of the bill short, rather strong and perpendicular, the head crested in all except the Pygmy Parrots (*Nasiterna*). This family contains at once the largest and the smallest of the Parrots.

THE GREAT PALM COCKATOO (*Microglossus* aterrimus*†).

This is one of the most powerful of all the Parrot tribe, measuring about twenty-four inches in length, and having a bill of unusual thickness and power. Its black plumage also renders it a conspicuous species, the only relief to this sombre colouring being the greyish crest and the dull crimson cheeks. Its home is New Guinea, but it is also found in the Cape York Peninsula in Australia, where it was discovered by John Macgillivray during the voyage of the *Rattlesnake*. He writes as follows respecting it :—"This very fine bird, which is not uncommon in the vicinity of Cape York, was usually found in the densest scrub among the tops of the tallest trees, but was occasionally seen in the open forest land perched on the largest of the *Eucalypti*, apparently resting on its passage from one belt of trees or patch of scrub to another. Like the Black Cockatoos, or *Calyptorhynchi*, it flies slowly and usually but a short distance. In November, 1849, the period of our last visit to Cape York, it was always found in pairs, very shy, and difficult of approach. Its cry is merely a low short whistle of a single note, which may be represented by the letters '*Hweet-Hweet*.' The stomach of the first one killed contained a few small pieces of quartz and triturated fragments of palm-cabbage, with which the crop of another specimen was completely filled ; and the idea immediately suggests itself, that the powerful bill of this bird is a most fitting instrument for stripping off the leaves near the summits of the *Seaforthia elegans* and other palms to enable it to arrive at the central tender shoot."

THE PYGMY PARROTS (*Nasiterna*).

These Parrots are represented by seven little manikins which are found in New Guinea and the adjacent islands, each particular island possessing its own peculiar species. Not one of these little birds exceeds a Sparrow in size, the largest being a little over three inches and a half in length. Owing to their small size and the resemblance of the green colouring to the forests they inhabit, they are not easily seen, and until recent years were very hard to procure. In the island of Mafoor in the Bay of Geelvink, N.W., New Guinea, Baron von Rosenberg says that he found it common near Roemsaro, and several specimens, both alive and dead, were brought to him by the natives. They bred there in January and February, nesting in hollow trees and laying two eggs, the size of those of the English Bottle Titmouse. Their food consists of fruit.

THE AMAZON PARROTS (*Androglossinæ*).‡

This, the second sub-family, consists of the true Parrots, of which the ordinary Grey Parrot (*Psittacus erythacus*) is the type. It also includes all the Green Parrots of America, which are called Amazons, as well as the Lories (*Eclectus*) and Love-birds (*Agapornis*). The head is moderately smooth, without any highly-developed crest, as in the Cockatoos, and the tail is short, or of only moderate length. The tail-feathers are generally broad and obtuse, in a few widening at the tip, or sharp at the end. In the genus *Prioniturus*, which inhabits the Philippine Islands, and some of the Moluccas, the two centre feathers have the shafts produced, and ending in a small spatule, or racket.

THE AMAZONS (*Chrysotis*).§

These Parrots are entirely American, and are the only birds of the New World which can compete in talking powers with the African Grey Parrots, who, however, far surpass their American relatives. About thirty species of Amazon are known, all of them confined within the limits of the Neotropical region, which comprises the whole of Central and Southern America, south of an imaginary line drawn through Northern Mexico. The West India islands are also included in this area, and most of them

* μικρός, small ; γλῶσσα, a tongue. † Very black. ‡ ἀνήρ, a man ; γλῶσσα, a tongue. § χρυσός, gold ; οὖς, an ear.

are inhabited by a species of Amazon. The habits of all these Parrots seem to be very similar, and a good account of the Active Amazon of Jamaica (*Chrysotis agilis*) is given by Mr. Gosse* :—"All the Parrots are gregarious, cunning, watchful, noisy, mischievous; and thus are like the Monkeys. This and the Yellow-billed Parrot [Mr. Gosse's name for *C. agilis* is the Black-billed Parrot] are so much alike in manners and general appearance, that a description of one applies nearly to the other. Flocks varying from half a dozen to twenty or thirty fly hither and thither over the forest, screeching as they go, and all alight together on some tree covered with berries. Here they feast, but with caution. On a slight alarm one screams, and the whole flock is on the wing, vociferous if not musical, and brilliant if not beautiful, particularly when the sun shines on their green backs and crimsoned wings. They generally prefer lofty trees, except when, in June, the ripe yellow plantain tempts them to descend, or when the blackberry shines upon the pimento. Of the latter the flocks devour an immense quantity, and the former they destroy by cutting it to pieces with their powerful beaks, to get at the small seeds. One day in January, when the pimento on the brow of Bluefields Mountain was about ready for picking, being full-sized, but yet green and hard, I observed large flocks of Black-bills, and a few Parrakeets, flying to and fro with voluble chatter, now alighting to feed on the hot, aromatic berry, now flying off, and wheeling round to the same neighbourhood again. They were not at all shy, but, with unusual carelessness of one's proximity, scarcely moved at the report of the gun which brought their companions to the ground. Of two which I shot on this occasion, I found the craws stuffed with the cotyledons of the seed alone, the most pungently aromatic part of the berry; the fleshy part having been, as I presume, shorn off by the beak and rejected. When alighted, as is often the case, on a dry branch, their emerald hue is conspicuous, and affords a fair mark for the gunner; but in a tree of full foliage, their colour proves an excellent concealment. They seem aware of this, and their sagacity prompts them to rely on it for security. Often we hear their voices proceeding from a certain tree, or else have marked the descent of a flock upon it, but on proceeding to the spot, though the eye has not wandered from it, and we are therefore sure that they are there, we cannot discover an individual.

AMAZON PARROT.

* "Birds of Jamaica," p. 260.

We go close to the tree, but all is silent, and still as death; we institute a careful survey of every part with the eye, to detect the slightest motion, or the form of a bird among the leaves, but in vain; we begin to think that they have stolen off unperceived, but on throwing a stone into the tree, a dozen throats burst forth into cry, and as many green birds rush forth upon the wing. The screaming of this and the following species differs from that of the Parrakeet, so far as to be easily distinguished. That of the latter consists of a series of harsh screeches, of comparative length; that of the Parrots is less shrill, more broken into short and rapid articulations, forming a series of varying length, separated by momentary pauses. It is, in fact, much more like a hurried chattering."

THE GREY PARROT (*Psittacus erythacus*).

This familiar cage-bird is a native of Africa, and it would appear to have been a favourite in England for a longer period than can be traced. They were held in great estimation at the court of the "Merry Monarch" Charles II., for his Queen Catharine of Braganza had a parrot-keeper, at a salary of £36 per annum, while the maids of honour received only £10 a year each, and the "mother of the maids" £20 per annum. Therefore, the custodian of the Parrots was better paid by £16 than the lady who held the very responsible post of care-taker of the maids of honour.* A Grey Parrot which lived for forty years with the Duchess of Richmond and Lennox, who died in 1702, and who was a celebrated beauty at the court of Charles II., is preserved in Westminster Abbey along with the effigy of that lady, having survived its mistress only a few days.

It is strange that for a bird which has so long been one of the chief pets in Europe, so little is known of its habits in a wild state, and at the present time not a single authentic egg of this species, taken in its native haunts, is known to exist. Occasionally it lays in confinement a white egg, like other Picarian birds, but it is probably from the care with which the species selects its breeding-place that it has been so difficult to find their nest and eggs. The only naturalist who appears to have discovered the latter appears to be the celebrated natural history artist, Mr. Keulemans, who spent nearly two years in West Africa, and has written the best account of the Grey Parrot in a state of nature,† as observed by him on Ilha do Principe, or Prince's Island, in the Bight of Biafra. Here it is very common, and breeds in the month of December in the very thickest forests. Only one pair breed in each tree, laying five eggs in a hole thereof, but a large number nest in close proximity to each other, many hundreds breeding in the same area, according to the above-named author. Both parents take a share in the rearing of the young birds, sitting by turns, the one who is thus relieved bringing food to its mate and feeding it out of its crop, which method is also adopted in the care of the young birds. The food of the Grey Parrot is stated to consist of palm-nuts, the arocat (*Laurus persea*), the banana (*Musa paradisea*), goyare, mango, and many other fruits of a smaller size; but it always gives the preference to palm-nuts. On Prince's Island, writes Mr. Keulemans, there is "a very lofty mountain, reaching some 1,200 feet above the level of the sea, and called by the natives 'Pico de Papagaio,' or Peak of the Parrots. On the slope of this mountain, and extending far up its side, is a magnificent forest. The trees are of great size and height, and their trunks and branches give support to the lianas and other climbing plants, which hang about them in luxurious folds. The density of the forest is so great that it is only with the greatest difficulty and toil that the explorer can force his way through it; while to the Parrots who come up there every night it presents no obstacle, but gives them, under the shelter of its thick foliage, a secure and pleasant resting-place."

Another observer in West Africa, Dr. Reichenow, found the Grey Parrot breeding in West Africa in the low-lands along the streams and groves of mangrove, and the great difficulty of traversing these swamps is, according to him, the reason why their breeding habits are not better known. They are very destructive to the crops of Indian corn, which they visit in large flocks, wasting as much as they consume. They proceed to roost in flocks, selecting the same route each night; and Governor Ussher says that, whilst up the river Addo, near Lagos, he has seen them crossing at sunset from their feeding-grounds to their roosting-places, when they presented the appearance of one continuous flock passing at a great distance overhead, their screams and chattering being heard long after darkness has

* G. D. Rowley, "Ornithological Miscellany," Vol. I., p. 175. † "Natural History of Cage-birds," Part I.

THE MACAWS' WALK, ZOOLOGICAL GARDENS, LONDON.

(From a Photograph by Symmons and Co., Chancery Lane, taken expressly for this work.)

set in. They are said by some travellers to be very good eating, but by others to be only good for soup.

The Grey Parrot in his native haunts is an unsociable bird, and a curious story is told by Dr. Dohrn, and confirmed by Mr. Keulemans, respecting the species in Prince's Island. As has already been stated, the Parrots are extremely common there, but not a single Kite is met with on the island. On the neighbouring island of St. Thomas there is an abundance of Black Kites but not a single Parrot, between whom and the Kites a constant warfare is waged, so that, should one of the latter get driven over to Prince's Island he is almost immediately set upon by the Parrots and slaughtered; and the compliment is returned if a Parrot is so unfortunate as to land uninvited on St. Thomas's. On the coast the chief enemy of the Parrots is the Vulturine Sea-Eagle (*Gypohierax angolensis*).

GREY PARROT.

The colouring of the Grey Parrot is simple, being of a clear bluish-grey, with a red tail. About the face the skin is white, and covered with a soft, velvety feathering, amongst which there is a plentiful supply of white powder, as any one knows who scratches the head of "Polly." This powder is present in most of the family, but not to the same degree as in the grey species. The young bird in the nest is stated to have the tail dark-grey instead of red, and it is more of a brownish-grey colour, not so clear as in the old bird, while the iris is grey instead of yellow.

The Conures (*Conurina*) are the third sub-family of Parrots, and are represented largely in America, only one genus, *Palæornis*, being found in India and Africa. They have the head devoid of a crest, with a very long graduated tail, and short and weak tarsi. Amongst the best-known species of this sub-family may be mentioned the Great Macaw.

THE ROSE-RINGED PARRAKEET (*Palæornis torquatus*).

This Parrot is probably the species of which we have the earliest known record, as Onesicritus, who was admiral of the fleet of Alexander the Great, is said to have brought from Ceylon a specimen of a green Parrot with a red neck. Many authors have supposed that the large Alexandrine Parrakeet (*Palæornis eupatrius*, or *Alexandri*) was the species referred to, but the habitat of this bird is now

known to be the island of Java, and the Rose-ringed Parrakeet is more probably the bird intended. Professor Sundevall, the great authority on Aristotle, believes that the present bird was the only Parrot known to the ancients, being brought into Europe probably from Nubia. Other species were not seen in Europe before the end of the Middle Ages, and the West African species, such as the Senegal Parrot (*P. senegalus*), in 1455, and the Grey Parrot even later; the latter not being described before Aldrovandus, about the year 1600. American species were brought already in 1493 by Christopher Columbus, and many Indian species after the circumnavigation of Africa about the year 1500. The present bird is common in India and Ceylon, and is, moreover, one of the few species of birds which are common to the Indian Peninsula and the continent of Africa, as it is a well-known bird in Nubia and Abyssinia, and on one occasion a flock has been seen in the neighbourhood of Port Elizabeth in the extreme south of the continent. According to Dr. Jerdon, it is one of the most common and familiar birds in India, frequenting cultivated ground and gardens, even in the barest and least wooded parts of the country, and it is habitually found about towns and villages, constantly perching on the house-top. It is very destructive to most kinds of grain, as well as to fruit-gardens. Burgess says that they carry off the ears of corn to trees to devour at leisure, and Jerdon has observed the same sometimes. When the grains are cut and housed it feeds on the ground in the stubble cornfields, also in meadows, picking up what seeds it can; and now and then takes long flights, hunting for any tree that may be in fruit, skimming close and examining every tree; and when it has made a discovery of one in fruit, circling round, and sailing with outspread and down-pointing wings till it alights on the tree. It associates in flocks of various size, sometimes in vast numbers, and generally many hundreds roost together in some garden or grove. At Saugor all the Parrakeets, Mynahs, Crows, Bee-eaters, &c., of the neighbourhood, for some miles around, roost in company in a large grove of bamboos; and the deafening noise heard there from before sunset till dark, and from the first dawn of day till long after sunrise, gives to the listener the idea of numberless noisy steam machines at work. Many of the flocks of Parrots are very late in returning, and fly along quite low, skimming the ground, and just rising over a tree, house, or any obstacle in the way, and, for several nights in succession, several Parrakeets flew against the wall of a house, on the top of a hill in

ROSE-RINGED PARRAKEET.

Saugor, and were killed. The Rose-ringed Parrakeet breeds both in holes in trees, and very commonly in the south of India about houses, in holes in old buildings, pagodas, tombs, &c. It lays four white eggs. Its breeding season is from January to March. Adams states that he has seen this Parrakeet pillage the nests of the Sand Martin; but with what intent he does not guess at. Its ordinary flight is rapid, with repeated strokes of the wings, somewhat wavy laterally, or arrowy. It has a harsh cry, which it always repeats when in flight, as well as at other times. Mr. Philipps remarks that the Kite will sometimes swoop down on them when perched on a tree, and carry one off in its talons; also that Owls attack these birds by night.*

The length of this species is about sixteen inches and a half. It is green with a black band extending from under the chin backwards nearly to the nape, and having a rose-coloured collar round the hind neck. The bill is cherry-red, the feet greyish, and the iris pale yellow. The female does not possess the rose-coloured collar, but has instead a narrower one of emerald green.

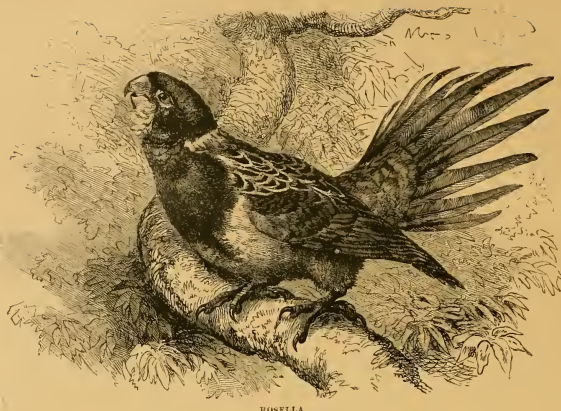
THE CAROLINA CONURE (*Conurus carolinensis*).

The Conures are inhabitants of the New World, and are very abundant in South America, but one species, the Carolina Conure, penetrating into the Nearctic region above the line of North Mexico. It is a very handsome bird, but is rapidly decreasing in numbers, and becoming restricted in its range, so much so, that in places where it was once plentiful it is now no longer to be found at all. Even in 1842, when Audubon wrote, they were then fast diminishing, and are now confined to the Southern and South-western States, as far west as the Missouri river. The food of the Carolina Conure is stated to consist chiefly of the seeds of the Cockle-burr (*Xanthirum strumarium*), but it is also very partial to fruit of all kinds, and it is owing to the way in which it has been shot down that it is now so rare, for Mr. Audubon describes the immense damage done by a flock of Conures to stacks of grain, which they covered in such numbers that they presented to the eye the same effect as if a brilliant-coloured carpet had been thrown over them. The farmers resented the attacks on their property to such an extent that the same naturalist states that he has seen hundreds killed in the course of a few hours, the survivors, after each shot, flying round for a few minutes, and then settling again in a place of most imminent danger. Even in confinement the birds seem to develop their destructive propensities, destroying wood, books, and, in short, everything that comes in their way, while from their incapability of talk, and their harsh, disagreeable voices, they are not much esteemed as pets. As Audubon observes, the woods are the habitation best fitted for them, and there the richness of their plumage, their beautiful mode of flight, and even their screams, afford welcome intimation that the darkest forests and most sequestered swamps are not destitute of charms. According to the same observer, they deposit their eggs, without making a nest, in the bottoms of such cavities in trees as those to which they usually retire at night. Many females deposit their eggs together, and he believed that the number laid by each hen bird was two; the eggs were greenish-white, and nearly round, and the young are at first covered with soft down, such as is seen in nestling Owls. The colour of this Parrot is green, the head and neck bright-yellow, and the forehead and region of the eye scarlet; the bill is white, the feet pale flesh-colour, and the iris hazel; the length of the bird being about fourteen inches. The female is like the male, but the young bird has the head green instead of yellow.

THE PARRAKEETS (*Platycercinæ*).

These form the fourth sub-family, and are remarkable for their slender, smooth tarsus, which is formed as in most birds; and the voice is more agreeable than in the other genera, the members of which, almost without exception, have a harsh and unpleasant cry. They are mostly inhabitants of Australia, whence come several of them well known as cage-birds, such as the King Parrakeet (*Platycercus scapulatus*), the Rosella, or Rose Parrakeet (*P. eximius*), and in America they are represented by the single genus *Bolborhynchus*.

* Jerdon, "Birds of India," I., p. 258.



ROSELLA.

THE OWL PARROT (*Strigops* habroptilus*†).

The genus *Strigops* is the sole representative of the fifth sub-family, the *Strigopinæ*. It is one of the most remarkable of all the Parrots, and is met with only in New Zealand. The face shows a disc exactly as in the Owls, whence the name, and the wing is very short, convex, and rounded. In its habits this bird is chiefly nocturnal, but not entirely so; the most remarkable fact connected with it being, perhaps, its unwillingness to fly. Thus Dr. Buller, F.R.S., in his excellent work on the "Birds of New Zealand," writes:—"All who have studied the bird in its natural state agree on this point, that the wings, although sufficiently large and strong, are perfectly useless for purposes of flight, and that the bird merely spreads them to break the force of its fall in descending from a higher point to a lower, when suddenly surprised; in some instances even this use of them is neglected, the bird falling to the ground like a stone. We are naturally led to ask how it is that a bird possessing large and well-formed wings should be found utterly incapable of flight. On removing the skin from the body it is seen that the muscles by means of which the movements of these anterior limbs are regulated are very well developed, but are largely overlaid with fat. The bird is known to be a ground-feeder, with a voracious appetite, and to subsist chiefly on vegetable mosses, which, possessing but little nutriment, require to be eaten in large quantities; and Dr. Haast informs us that he has sometimes seen them with their crops so distended and heavy, that the birds were scarcely able to move. These mosses cover the ground and the roots or trunks of prostrate trees, requiring to be sought for on foot; and the bird's habit of feeding at night, in a country where there are no indigenous predatory quadrupeds, would render flight a superfluous exertion, and a faculty of no especial advantage in the struggle for existence. Thus it may be reasonably inferred that *disuse*, under the usual operations of the laws of nature, has occasioned this disability of wing; for there is no physiological reason why the Kakapo should not be as good a flier as any other Parrot."

The Kakapo, as it is called in New Zealand, meaning a "Night Parrot," is becoming rarer every year, as the places which it affects become more and more accessible to the colonists. From the long accounts of its habits given in Dr. Buller's work, the following note of Dr. Haast is selected, as it

* στρίγξ, an Owl; ὤψ, a face, *i.e.*, having the appearance of an Owl. † ἁβρός, soft; πτίλον, feather.

gives a good idea of the habits of this singular species :—"So little is known of this solitary inhabitant of our primæval forests, that the following short narrative of observations, which I was fortunate enough to make during my recent West Coast journey, may interest you. Although I was travelling almost continuously for several years in the interior of these islands, it was only during my last journey that I was enabled to study its natural history. I was well acquainted with its call, and had often observed its tracks in the sands of the river-beds and in the fresh-fallen snow, but I had not actually seen it. The principal reason for this was, that formerly I had no dog with me; and consequently it would only be by the greatest accident that this bird, not at all rare in those untrodden regions, could be obtained. The true habitat of the Kakapo is the mossy *Fagus* forest, near mountain streams, with occasional grassy plots; but it also lives both on the hill-sides, amongst enormous blocks of rock, mostly overgrown with roots of trees and a deep covering of moss, and on wooded flats along the banks of the larger rivers, liable to be inundated by heavy rainfalls or by the sudden melting of the snow. . . . . It is a striking fact, that—with the exception only of the valley of the river Makarora, forming Lake Wanaka—I never found the Kakapo on the eastern side of the Alps, although extensive *Fagus* forests exist there also. It appears to have crossed the main chain at the low wooded pass which leads from the source of the Haast to that of the Makarora, and reached the mouth of this river at Lake Wanaka, where probably the absence of forest put a stop to its farther advance. It is very abundant in the valley of the last-mentioned river, and is found even in the Makarora bush, notwithstanding that numerous sawyers are at work there. When camped on the borders of that forest we continually heard its call near our tents; but none of the sawyers had any idea of the existence of such a large bird in their neighbourhood, although the irregular shrill call had sometimes attracted their attention. It also occurs in the valley of the Wilkin, but is less numerous there, which may be accounted for by the existence of wild dogs in this locality. We may therefore safely assume that from the junction of this river with the Makarora the Kakapo ascended toward the sources of the former. In the valley of the Hunter, only divided by a mountain-range of great altitude but with some low saddles, no sign of it was to be observed, although large *Fagus* forests would appear to offer a propitious abode. This bird has hitherto been pronounced to be of true nocturnal habits; but I think, from observations I was able to make, that this opinion ought to be somewhat modified. It is true that generally an hour after sunset, the dense foliage of the forest giving additional darkness to the country, its call began to be heard all around us. It then commenced to rove about, and, attracted by the glare of our camp-fire, frequently came close to our tent, when the heedless bird was immediately caught by our dog. But as we met with it on two occasions in the daytime, occupied in feeding, and as I observed that it knew and understood perfectly well the danger which approached, we may assume that it has, at least in this respect, some relation to diurnal birds. In order to show why I come to this conclusion, I will particularise the two occurrences I have mentioned, as they appear to bear directly upon some other important points in the structure of this bird. When returning from the West Coast, we observed in the afternoon (the sky being clouded) a Kakapo sitting on the prostrate trunk of a tree in the open forest. When about ten yards from it, the bird observed us, and disappeared instantly in its hole, whence, with the aid of the dog, we afterwards took it. It is clear that in this case the bird was not overtaken by the

OWL PARROT. (*After Keulemans.*)

coming day when far from its abode, but that it left its retreat voluntarily during daylight. The second instance I shall mention is more striking, and shows that the Kakapo feeds also during the day. It was towards evening, but still broad daylight, when we passed along the hill-side near a deep rocky gorge, and saw a large Kakapo sitting on a low fuchsia-tree, about ten feet from the ground, feeding on the berries. When close to it, the bird saw us, and instantly dropped down as if shot, and disappeared amongst the huge fragments of rocks strewed along the hill-side. But the most remarkable circumstance was, that the frightened bird did not open its wings to break its fall, but dropped as if it did not possess any wings at all. In order to see whether they would fly, or even flutter, when pursued by an enemy, I placed on the ground a full-grown specimen, which had been caught by the dog without being hurt. It was on a large shingle-bed, so that the bird had ample room for running or rising on the wing, if for this purpose it wanted space. I was not a little astonished to observe that it only started running towards the nearest point of the forest, where a dark shadow was apparent, and it went quicker than I had anticipated, considering the position of its toes and its clumsy figure, its gait resembling closely that of a Gallinaceous bird in its movements. As I was standing sideways to it, I thought that it kept its wings closed upon its body, so little were they opened; but my companion, who was equally anxious to see how our prisoner would try to escape, and who stood a little behind it, observed that it opened its wings slightly, but without flapping them in any degree, using them apparently more for keeping its balance than for accelerating its movements. This would almost lead to the conclusion that the Kakapo does not travel far, especially as I have already shown that its whole structure is ill adapted for running. But having myself frequently followed its tracks, and found them to extend a great distance over the sandy reaches along the river, such a conclusion as that suggested above would be erroneous. It must be exceedingly fond of water, because in many localities its tracks were observed for half a mile over shingle and sand to the banks of the river; and I am unable to explain the curious fact, unless the object be to mix river water with the enormous mass of pulpy vegetable matter which is to be found in its crop. With the exception of two specimens, the crops of which were filled with the large berries of a small-leaved *Coriaria*, by which their flesh was flavoured, all the birds examined by me had their crops widely distended by a mass of finely-comminuted vegetable mosses, weighing many ounces.

"I carefully examined the subterranean abode of this bird. From the account given by the natives, I thought that it would be found living in well-excavated holes, resembling in their construction those of the Fox or Badger; that the entrance would be so small as to enable only the inhabitants to enter, and thus to exclude larger animals from persecuting it. This, however, is not the case; because, with one exception, all the specimens obtained were either in fissures amongst rocks, or in cavities formed by huge blocks tumbled one over another, and overgrown with moss, or in holes formed by the roots of decayed trees. The cavities in the rocks were generally sufficiently large to allow of my dog, a good-sized Retriever, freely entering them. The openings to the other holes were smaller, and it was sometimes necessary to cut away a few roots at the entrance. Inside, the cavity was invariably of very large size, because we could plainly hear the dog advancing several yards before commencing his scuffle with the occupant; and on returning with the bird in his mouth, he always emerged head foremost, thus proving that the chamber was large enough to enable him to turn himself round. Before he had become accustomed to the work, the dog was often punished severely by the bird's powerful beak and claws; but he ultimately became quite an expert, always seizing his prey by the head and crushing the skull.

"The holes or abodes of the Kakapo were not only on the mountain sides, but also on the flats near the river banks which are liable to be overflowed. There can be no doubt that when a sudden inundation takes place the bird can save itself upon a bush or neighbouring tree. I do not think, however, that it can climb the boles of standing trees, because it never resorted to them during the night or when persecuted by the dog—except in one single case, when the bird ascended a leaning tree close to our camp, and remained till the dog had given up the attempt to obtain it. But, notwithstanding that almost all the abodes that came under examination were natural cavities, I met with one hole that seemed to have been regularly mined. On the northern bank of the river Haast, just below the junction of the river Clarke, a large flat occurs, formed by deposits of sand, over which a thin layer of vegetable mould is spread, and on which a luxuriant vegetation has sprung up. The

river, in washing against these deposits, has in some cases formed nearly perpendicular banks, about six to eight feet high. At one spot, about two feet below the surface, several rounded holes were observed, and the dog tried in vain to enter them. After carefully scenting the ground, he began to scratch the surface with his paws, and soon succeeded in widening the entrance sufficiently to admit his body, and he immediately afterwards emerged with the bird in his mouth. There is no doubt in my own mind that this hole at least had been excavated; and the burrowing faculty of the bird may be considered so far established. On a flat in the valley of the Makarora, the dog brought one from the interior of a hollow drift-tree, which was lying amongst sedges and grasses in an old river channel. There never was more than one individual in the hole, although very often, within twenty or thirty yards of it, another specimen would be scented out by the dog, the two being generally of opposite sexes. At night-time, in visiting our camp fire, they generally came in pairs, the two being successively caught by my dog, a single or sometimes a repeated angry growl from the bird informing us that he had hold of it. These circumstances lead me to conclude that during the day each inhabits separately its own hole, and that only after dark do they meet for feeding and for social intercourse."

In size, the Owl Parrot is about twenty-six inches in length, and is of a dark sap-green colour, varied and mottled with dark brown and yellow; the face is lighter, being darker brown, the ear-coverts mixed with yellow; the belly and under tail-coverts, as well as the wing-lining, are rather brighter yellow than the rest of the under surface. The tint of green varies a good deal: from light yellowish to dark sap-green.

THE STRAIGHT-BILLED PARROTS (*Psittaci orthognathi*).*

In this second section of the Parrots only one family is known, all the members of which are easily recognisable by their straightened bills, the lower mandible being gently compressed, and not

LORIKEET.

bulged out, with a nearly straight tip, the cutting edges with scarcely any indentation. With the exception of the Lorikeets (*Loriculus*), members of which are found in India and the Indo-Malayan region, the whole family is Australian, being confined to that continent and the adjacent Moluccа Islands, New Zealand, and the islands of Polynesia.

* ὀρθός, straight; γνάθος, jaw.

THE BRUSH-TONGUED PARROTS.*

The Brush-tongued Lorikeets are all birds of very beautiful colouring, and are mostly found in Australia, the Moluccas, some few species extending through the Oceanic Islands. All seem to be very similar in their habits, an account of which is given by Mr. Gould. He says:—"This arboreal group of honey-eating Lorikeets, if not so numerous in species as the seed-feeding Parrakeets, is individually as abundant, and more universally dispersed, being found in every part of Australia yet visited. In their structure, habits, food, and mode of nidification, no two groups of the same family can be more widely different than these forms: the pencilled tongue, the diminutive stomach, thick skin, tough flesh, and fetid odour of the *Trichoglossi* presenting a decided contrast to the simple tongue, capacious crop and stomach, thin skin, delicate flesh, and freedom from odour of the *Platycerci*; besides which, the *Trichoglossi* possess a strong *os furcatorium*, which bone is wanting in the *Platycerci*. Hence, while the *Trichoglossi* are powerful, swift, and arrow-like in their flight, the *Platycerci* are feeble, pass through the air in a succession of undulations near the ground, and never fly to any great distance. The mode in which the two groups approach, alight upon, and quit the trees is also remarkably different—the *Trichoglossi* dashing among and alighting upon the branches simultaneously and with the utmost rapidity, and quitting them in like manner, leaving the deafening sound of their thousand voices echoing through the woods; while the *Platycerci* rise to the branch after their undulating flight, and leave them again in a quiet manner, no sound being heard but their inward piping note. The eggs of the *Trichoglossi* are from two to four in number; those of the others are more numerous."

THE NESTORS (*Nestor*).

These Parrots, which are only found in New Zealand, are generally placed with the other Brush-tongued Parrots. "In all Parrots the fleshy tongue ends anteriorly in a dilated portion, supported by a narrower neck. This tip is much like the end of a human finger, as mentioned by most observers; and its function is similar also, for it is employed by the bird as a third prehensile organ in connection with the upper and lower beak, any solid substance being held by the tongue and upper beak, while the mandible is freed to give another bite. Continuing the simile of the finger, the tip is directed forwards with the nail-like portion downwards, the part corresponding to the free edge of the nail appearing along the lower margin of the anterior rounded surface.† In the *Trichoglossi*, this 'nail,' or horny plate, is stated to be present; but on the superior surface of the tongue, between the lateral edges of the unguis, or nail, there is an arrangement of retroverted papillæ, forming a spinous covering, and their mechanism is such that when the tongue is protruded beyond the mouth to grasp any object, the papillæ stand upright, or are even directed somewhat forward. In Nestor," continues Professor Garrod, "there are no papillæ of this description; but the tongue is here, as Dr. Buller says, 'soft, rounded on the edges, with a broad central groove,' and it is as smooth as in other Parrots. Therefore, the Kaka Parrot cannot in this point be said to approach the *Trichoglossini* (badly so called). The peculiarity of the tongue of *Nestor* consists in the fact that the interior edge of the unguis, or nail, always free (though for a very short distance) and jagged in the other birds of the class, is here prolonged forwards beyond the tips of the tongue for about one-tenth of an inch, as a delicate fringe of hairs with a crescentic contour. In the living bird the mouth is moist, as in the Lories, and not, as in the Cockatoos and others, dry and scaly."

TONGUE OF NESTOR. (*After Garrod.*)

The members of the genus *Nestor* are entirely confined to New Zealand, the species of Philip Island (*Nestor productus*) being now extinct. Their habits, like those of all New Zealand birds, are sufficiently curious, one of them, known as the "Kea" (*N. notabilis*), actually feeding on raw flesh, as is noticed by Dr. Buller:—"Those that frequent the sheep stations appear to live almost exclusively on flesh. They claim the sheep's heads that are thrown out from the slaughter-shed, and pick them perfectly clean, leaving nothing but the bones." An eye-witness described this operation to Dr. Hector as follows:—"Perching itself on the sheep's head or other offal, the bird proceeds to tear off

* *Trichoglossi.* † Professor Garrod in *Proceedings of the Zoological Society for* 1872, p. 787.

the skin and flesh, devouring it piecemeal, after the manner of a Hawk; or at other times holding the object down with one foot, and with the other grasping the portion it was eating, after the ordinary fashion of Parrots." Dr. Buller also mentions instances of tame Parrots devouring their comrades in captivity; but the Kea is the only Parrot known to eat flesh when flying wild.

THE KAKA PARROT (*Nestor meridionalis*).

This Parrot is best described by the above-named ornithologist in the work on the Birds of New Zealand, to which frequent reference has been made in these pages:—"Sprightly in its actions, eminently social, and more noisy than any other inhabitant of the woods, the Kaka holds a prominent place among our native birds. Being semi-nocturnal in its habits, it generally remains quiet and concealed during the heat of the day. If, however, the sportsman should happen to find a stray one, and to wound instead of killing it, its cries of distress will immediately rouse the whole fraternity from their slumbers, and all the Kakas within hearing will come to the rescue, and make the forest echo with their discordant screams. Unless, however, disturbed by some exciting cause of this sort, they remain in close cover till the approach of the cooler hours. Then they come forth with noisy clamour, and may be seen, far above the tree-tops, winging their way to some favourite feeding-place; or they may be observed climbing up the rough vine-clad boles of the trees, freely using their powerful mandibles, and assuming every variety of attitude, or diligently tearing open the dead roots of the close epiphytic vegetation in their eager search for insects and their larvæ. In the spring and summer, when the woods are full of wild blossom and berry, these birds have a prodigality of food, and may be seen alternately filling their crops with a variety of juicy berries, or sucking nectar from the crimson flowers of the rata (*Metrosideros robusta*) by means of their brush-fringed tongues. With the earliest streaks of dawn, and while the underwoods are still wrapped in darkness, the wild cry of this bird breaks upon the ear with a strange effect. It is the sound that wakes the weary traveller encamped in the bush; and the announcement of his ever active Maori attendant—'Kua tangi te Kaka'—is an intimation that it is time to be active. But although habitually recluse during the day, it is not always so.

KAKA PARROT.

"During gloomy weather it is often very active; and sometimes even in the bright sunshine a score of them may be seen together, flying and circling about high above the tree-tops, uttering their loud screams, and apparently bent on convivial amusement. When the shades of evening bring a deeper gloom into the depths of the forest, and all sounds are hushed, save the low hoot of the waking Morepork, or the occasional *cheep-cheep* of the startled Robin, the Kaka becomes more animated. It may then be heard calling to its fellows in a harsh rasping note, something like the syllables '*t-chrut, t-chrut,*' or indulging in a clear musical whistle with a short refrain. It is strictly arboreal in its habits, and subsists to a large extent on insects and their larvæ, so that it is probably one of our most useful species. Where they exist in large numbers they must act very beneficially on the timber forests; for in the domain of Nature important results are often produced by apparently trivial agencies. Like all the honey-eaters, while supplying their own wants, they do good service with their brush tongues by fertilising the blossoms of various trees, and thus assisting in their propagation; while, on the other hand, the diligent search they prosecute for insects and grubs, and the countless numbers daily consumed by each individual, must materially affect the economy of the native woods. On this latter point Mr. Potts has furnished the following valuable note:—'Although so often accused of injuring trees by stripping down the bark, from careful observation we do not believe a flourishing tree is ever damaged by its beak. It is the apparently vigorous, but really unsound, tree that is attacked, already doomed by the presence of countless multitudes of insects of many varieties, of which it is at once the food and refuge, either in their perfect or larval state. In the persevering and laborious pursuit of this favourite food, the Kaka doubtless lends his assistance in hastening the fall of decaying trees; the loosened strips of bark dissevered admit to the exposed wood rain and moisture collected from dews and mists, to be dried by evaporation by the heat of the sun, by the desiccating winds, only to become saturated again. Under this alternation the insidious fungi take root, decay rapidly sets in, the close-grained timber gives place to a soft spongy texture, branches drop off, and gradually the once noble-looking tree succumbs to its fate; but its gradual decay and fall, the work of years, has proved beneficial to the surrounding plants: the dropping of the branches admits light and air to the aspiring saplings, assists in checking the undue spread of lichens and epiphytes; and when the old stem falls, tottering down from its very rottenness, its place is supplied by vigorous successors.'

"In estimating the value of the labours of the Kaka as an insect-eater, it should not be forgotten that the family of Woodpeckers is entirely absent from our bird-fauna, and that upon this indefatigable climber devolves some share of the duty of representing that peculiar group of forest birds. How diligently the insects are sought for by the Kaka may be judged from the heaps of bark chips that lie beneath the decaying trees. Often it may be noticed on the ground tearing away the mossy clothing of the huge gnarled roots that spread around; even the soft rotten boughs are gnawed to obtain the larvæ of some of the larger bush insects."

The Nestors vary immensely in colour, so that many of the plumages now known to be only occasional varieties have been supposed to be specifically distinct. They are birds of large size, and have the cere, or fleshy portion at the base of the bill, rather strongly developed, the bill being large and powerful. The colour is of an olivaceous brown, with a dash of dark red, the crown grey, and the ear-coverts shaded with orange, the cheeks with dark red, as also are the lower back, rump, and upper tail-coverts and abdomen.

The structure of the bill of the Parrots is so remarkable as to be worthy of a more extended description than could be given to it when it was incidentally referred to in our account of the osteology of birds in general. The way, however, in which the upper and lower jaws are connected with the skull was there explained, and a reference to the description on pp. 241–2 will save the necessity of much repetition now. That account embraced all members of the class of birds; here we are dealing only with certain peculiar modifications.

If the skull of an adult bird of any familiar type, such as a Crow, be examined, it will be seen that the bones of the upper jaw are apparently continuous, and form one piece, with those of the forehead and sides of the head. There is nothing that looks like a joint, or "articulation," between the bill where it is attached to the forehead above, or to the long jugal arch ("quadrato-jugal") that runs each side to reach the quadrate bone, or to the flattened bones that help to

form the palate below. But if the skull of this same bird had been carefully examined in an earlier stage of its existence, it would have been found that the bones were at first distinctly separate at the three points here indicated, and were merely connected by a soft membranous substance. In many birds this "inter-osseous" membrane connecting the bones of the upper mandible with the skull proper never becomes true bone at all, but remains throughout life more or less soft and flexible. And by this means a sort of elastic joint is established, conferring upon the beak a certain range of up and down motion.

Now in Parrots, more conspicuously than in any other birds, each of these joints, not alone that of the beak with the forehead, is converted into a true hinge-like articulation, so that the upper jaw can be raised to a very considerable extent; and to effect this motion the muscles of the palate are developed into a somewhat complex apparatus.

SKULL OF THE GREY PARROT.

If the figure be examined, the actual relations of the bones can be readily made out. At *a* is seen the line where the bill is articulated to the frontal bones. At *b* is the joint which the bill makes with the long jugal bone (*j*). And at *c* is its articulation with the palatine bone (*pl*).

But it is not this mobility of the upper mandible alone that gives the characteristic aspect to the Parrot's face. There are several other points in which Parrots agree, with a wonderful uniformity, among themselves, and differ from most other birds. Besides the absence of certain important processes, called "basi-pterygoid," the ploughshare-like bone, or "vomer," is altogether wanting. The maxillo-palatines are very largely developed and spongy; they unite with one another in the middle line, and with the thick wall of bone into which the *septum nasi* is in Parrots strongly ossified, and thus fill up almost the whole base of the beak. The long palatine bones proper are remarkably flattened from side to side for most of their length; their hinder edges are more or less notched, and quite free from any bony attachment; and they are united at about the hinder third of their length by a plate-like extension from each. The scoop-like lower mandible, with its tip that seems to have been cut off "square," to be out of the way of the strongly-hooked upper jaw, is too familiar to call for any particular description.

THE SECOND ORDER.—PICARIAN BIRDS. SUB-ORDER I.—ZYGODACTYLÆ.

CHAPTER VIII.

CUCKOOS—HONEY GUIDES—PLAINTAIN-EATERS—WOODPECKERS—TOUCANS—BARBETS.

THE CUCKOOS—The Bush Cuckoos—The Lark-heeled Cuckoos, or Coucals—The Common Cuckoo—Its Characteristics—Mrs. Blackburn's Account of a Young Cuckoo Ejecting a Tenant—Breeding Habits—The Eggs—The Call-notes of Male and Female—Food—Its Winter Home—Its Appearance and Plumage—THE HONEY GUIDES—Kirk's Account of their Habits—Mrs. Barber's Refutation of a Calumny against the Bird—THE PLANTAIN-EATERS—The White-crested Plaintain-eater—The Grey Plantain-eater—The Colies—The White-backed Coly—THE WOODPECKERS—How they Climb and Descend Trees—Their Bill—Do they Damage Sound Trees?—The Wrynecks—The Yaffle—The Red-headed Woodpecker—The Spotted Woodpecker—THE TOUCANS—Mr. Gould's Account of their Habits—Mr. Waterton's Account—The Enormous Bill—Azara's Description of the Bird—Mr. Bates' History of a Tame Toucan—THE BARBETS—Messrs. Marshall's Account of the Family—Mr. Layard on their Habits.

THE SECOND ORDER OF ZYGODACTYLE PICARIAN BIRDS.—THE CUCKOOS (*Cuculidæ*).

Within the limits of this family are comprised birds of very different habits and of very different structure, some being inhabitants of the ground and of the thick bush, whilst others are lovers of the open, and are birds of very strong flight. Without being able to climb up the trunks of trees,

like our Woodpeckers, the Cuckoos possess the zygodactyle foot of the climbing bird in a very perfect degree. They differ from others of the Scansorial group by the position of the nostrils, which are placed rather low in the upper mandible, not far from the cutting edge of it. There are three sub-families of Cuckoos, distinguished by the form of the wing: the first of these has the wings short, rounded, and with from two to six, or even seven, of the primaries slightly indented in the middle. They have the feathers of the thigh close-set, and not over-hanging like those of a Hawk, as is the case with the true Cuckoos.

THE BUSH CUCKOOS (*Phænicophæinæ*).

These birds have representatives in India, Australia, and Africa, and even South America. Some of them are of very varied and beautiful plumages, and many of them reach the size of a moderate game-bird. The first genus of these Bush Cuckoos contains

THE LARK-HEELED CUCKOOS, OR COUCALS (*Centropus*).

These are remarkable for the form of the hind toe, which is furnished with a straight nail or claw, very strong, always equalling and often surpassing the length of the hind toe itself. These Lark-heeled Cuckoos do not occur in Europe, but are found all over Africa, India, and Burmah, to China, and throughout the Malayan Archipelago to Australia. They frequent the thick bush, and have a very similar call-note, which has been rendered by some observers as resembling the syllables "*bop bop*," while on the West Coast of Africa, from their cry "*hoot, hoot*," they have been nicknamed by the colonists the "Scotchman." Writing of the Eyebrowed Lark-heel, Mr. Thomas Ayres says:—"This bird frequents the dense bush, and principally lives amongst impenetrable creepers, where it hunts about in search of the insects which it feeds upon; if disturbed, it flies but a short distance. The note is a loud, melancholy, cooing noise; they call most in wet weather. They are fond of getting up into trees that are covered with creeping plants, and sunning themselves; they generally fly on to the lower part, and then gradually hop upwards till they gain the top, but they can fly a very short distance at a time, and are easily caught if chased out into the open grass, though they lie very close, and it requires a good dog to find them. If disturbed, they immediately fly to the thickest cover near at hand, and commence running, like the Rails." Mr. Ayres says that they feed on Grasshoppers, Caterpillars, and other insects; but Mr. Rickard, another excellent field naturalist, in South Africa has found a small Snake and Locusts in their stomachs, one having a small bird—a White-eye (*Zosterops*)—inside him. The Lark-heeled Cuckoos are not parasitic, like the true Cuckoos and many others: that is to say, they build their own nests, and do not employ the nests of other birds to place their eggs in. When hatched, the young birds are very curious, being covered with long hairs and bristles. In colour the Lark-heels are for the most part rufous, with black heads, but some of them are almost entirely rufous, the shafts of all the feathers much stiffened, so that the plumage lies very close, which must be of advantage to birds who have to climb a great deal amongst the lianas and creepers of tropical forests.

Of the Indian Coucal (*Centropus bengalensis*) an interesting account is given by Mr. Gammie, which affords a very good idea of the habits of these Bush Cuckoos. He says:—"This species has increased largely of late. Among grassy scrub, up to 3,500 feet, it is now abundant, where, only a few years ago, it was rarely to be found. In the earlier part of the rainy season its odd, monotonous notes are to be heard in every direction. I am not sure that the male calls, but have shot the female—as I found by dissection—when calling. It has a call of a double series of notes: '*whoot, whoot, whoot, whoot;*' then, after a pause of four or five seconds, '*kurook, kurook, kurook, kurook.*' The 'whoot' is quite ventriloquistic, sounding as if it came from a distance of six or seven yards from the bird. Before calling, it seats itself about five feet from the ground; then you see it draw its neck and body together, slightly puffing out its body-feathers, raising its back, and depressing its tail, and for every 'whoot' there is a violent throb of the body, as if the bird was in great pain; at the same time the motion of the throat is scarcely perceptible, and its bill is closed. Then, as if greatly relieved, it stretches itself out, the feathers fall smooth, and with open mouth and throbbing throat comes the 'kurook,' without the slightest attempt at ventriloquism. When searching for the caller, one must take no notice of the 'whoot,' but wait for the 'kurook.'

It feeds almost entirely on Grasshoppers, and frequents the open, scrubby tracts only. I have never once seen it in larger forests."*

The Malkohas are another remarkable group of the Bush Cuckoos, and are found throughout India, Ceylon, the Indo-Malayan region and islands, as far as the Celebes. The genera differ principally in the shape of the nostril; and although differences of structure are usually considered sufficient characters on which to found distinctions of genus, some ornithologists are of opinion that the variation in the form of the nostril only separates them as species. One of the most remarkable of these Bush Cuckoos is the *Carpococcyx radiatus* of Borneo, which, when alive, is stated by Mr. Wallace to resemble a Pheasant in appearance and gait. It lives much on the ground, and is often caught by the Malays in the snares which they set for Argus Pheasants and other game-birds. In Madagascar they are represented by the Couas (*Sericosomus*), of which there are no less than ten species found in that island. They are the inhabitants of the Palestrina forests, where their monotonous notes are often heard. The cry of the Blue Cuckoo is said by Messrs. Pollen and Van Dam to resemble the syllables *cir-cir-cir*, while that of the Crested Coua (*S. cristatus*) is *toc-toc-toc*. When calling, the latter bird raises its crest and flaps its tail and wings. Its flight is difficult and generally descending, and the bird never flaps its wings when it flies. It is ordinarily seen on the lower branches of the trees, and loves to repose during the great heat of the day in the sheltered parts of the trees, resting on the branches and puffing out its feathers.

In America there are several allied forms of Bush Cuckoos, many of which frequent the ground, one of the most interesting being the *Geococcyx californianus*, which is called the "Road-runner," and is a bird of such powers of running that it is sometimes hunted on horseback and pursued with hounds, a test of fleetness in which it is said often to make a longer race than its pursuers anticipated.

THE COMMON CUCKOO (*Cuculus canorus*).

The true Cuckoos, of which the English bird is the type, differ from the Bush Cuckoos in being more *Accipitrine*, or Hawk-like, in their appearance, and having long thigh-feathers, like the majority of the birds of prey. The nostril is swollen and rounded. It would be easy to write a complete book on this mysterious bird, whose habits and cry have rendered it an object of interest in all countries and from very early times. The popular superstition concerning the nestling—that the young Cuckoo, when sufficiently grown, and having no further use for the little foster-parent to whose care it owed its life and well-being, used to devour the latter—has often been held up as an "awful example" to ungrateful children who become a burden and a shame to their parents when they are unable to provide for them any longer. The idea of the young Cuckoo devouring its protector is no doubt erroneous, and, as Brehm puts it, has arisen from the oft-recurring spectacle of a little Wren or a diminutive Gold-crest placing food in the wide-gaping mouth of the young Cuckoo, which, indeed, without much stretch of the imagination, might swallow it. In Mr. Gould's "Birds of Great Britain" there is a picture showing the *dénouement* of the young Cuckoo's story, when, still callow and blind, it is represented as disposing of some unfortunate little Tree Pipits which were hatched along with it in the same nest. This incident was sketched by Mrs. Hugh Blackburn, who thus describes the occurrence:—"The nest (which we watched last June, after finding the Cuckoo's egg in it) was that of the common Meadow Pipit (Titlark, Mosscheeper), and had two Pipit's eggs besides that of the Cuckoo. It was below a heather bush on the declivity of a low abrupt bank or highland hill-side, in Moidart. At one visit the Pipits were found to be hatched, but not the Cuckoo. At the next visit, which was after an interval of forty-eight hours, we found the young Cuckoo alone in the nest, and both the young Pipits lying down the bank, about ten inches from the margin of the nest, but quite lively after being warmed in the hand. They were replaced in the nest beside the Cuckoo, which struggled about till it got its back under one of them, when it climbed backwards directly up the open side of the nest, and hitched the Pipit from its back on to the edge. It then stood quite upright on its legs, which were straddled wide apart, with the claws firmly fixed half-way down the inside of the nest among the interlacing fibres of which the nest was woven, and

* "Stray Feathers," 1877, p. 385

stretching its wings apart and backwards, it elbowed the Pipit fairly over the margin so far that its struggles took it down the bank instead of back into the nest. After this the Cuckoo stood a minute or two, feeling back with its wings, as if to make sure that the Pipit was fairly overboard, and then subsided into the bottom of the nest. As it was getting late, and the Cuckoo did not immediately set to work on the other nestling, I replaced the ejected one and went home. On returning next day, both nestlings were found dead and cold out of the nest. I replaced one of them, but the Cuckoo made no effort to get under it and eject it, but seated itself contentedly on the top of it. All this I find accords accurately with Jenner's description of what he saw. But what struck me most was this: the Cuckoo was perfectly naked, without the vestige of a feather, or even a hint of future feathers; its eyes were not yet opened, and its neck seemed too weak to support

COMMON CUCKOO.

the weight of its head. The Pipits had well-developed quills on the wings and back, and had bright eyes, partially open; yet they seemed quite helpless under the manipulations of the Cuckoo, which looked a much less developed creature. The Cuckoo's legs, however, seemed very muscular, and it appeared to feel about with its wings, which were absolutely featherless, as with hands; the spurious wing (unusually large in proportion) looked like a spread-out thumb. The most singular thing of all was the direct purpose with which the blind little monster made for the open side of the nest, the only part where it could throw its burden down the bank. I think all the spectators felt the sort of horror and awe at the apparent inadequacy of the creature's intelligence to its acts that one might have felt at seeing a toothless hag raise a ghost by an incantation. It was horribly 'uncanny' and 'gruesome!'"

The above account of Mrs. Blackburn's graphically describes the ejection of its foster-brothers and sisters by the nestling Cuckoo; and this brings us to the next part of the subject, viz., the breeding habits of this curious bird. As is well known of the hen bird, it never makes its own nest, but it is believed that during its stay in Europe it lays altogether about eight eggs, all of which are deposited

in the nest of some other bird. The variation in the colour of the Cuckoo's eggs is very great, from a white speckled egg, like that of the Water Wagtail, or the dark brown mottled egg of a Lark or Pipit, to the blue egg of the Hedge Sparrow; while Mr. Dresser states that he has seen even green eggs, and is of opinion that the same female will lay similarly coloured eggs. The researches of ornithologists during recent years sufficiently prove that the female Cuckoo lays her egg upon the ground, and then deposits it in the nest of a bird whose egg resembles the one she has just laid; hence it is probable that a hen Cuckoo killed with a broken egg in its mouth is the rightful owner of the latter, and has not been sucking the eggs of some other bird, as the species is often supposed to do. The writer has on many occasions found Cuckoos' eggs in the nest of the Water Wagtail in Berkshire, the latter bird being frequently selected by the Cuckoo as her victim; and he can affirm that the eggs were in all cases similar to those of the Wagtail, but were a little larger in size. In due time the young Cuckoo is hatched, the rightful owners of the nest ejected, and for weeks the powers of the unhappy foster-parents are exercised to the utmost in feeding the gaping and constantly-complaining occupant of their domain. Even when the young Cuckoo has outgrown the nest, and is strong enough to fly about, he is still attended by his foster-parents. So great is the instinct of the young Cuckoo to receive food from other birds, that a specimen in the Zoological Gardens which managed to live through the winter and put on his full plumage in the following spring, on the appearance of a Hedge Sparrow in the same aviary, fluttered down, and with drooping wings and open bill solicited food from his small companion.

The reason for the parasitic habits of the Cuckoo is hard to discover, but it appears probable that the number of males greatly exceeds that of the females, and one observer has calculated that the preponderance of the former sex over the latter is as much as twenty-five to one. This would seem to be too large an estimate, but the proportion is probably about five males to one female. The latter may not only be distinguished by its somewhat darker plumage, and a certain red colour on the chest (which is more apparent when the bird is alive), but has a somewhat different note from that of her mate, and calls *cuckoo* in a much sharper and less emphasised way than the male bird. Thus, if the call of the female be represented by the syllables *cŭck-oo*, the responsive utterance of the male would be *coo-coo*. The female has also another call-note, which may be described as "whittling," and is well expressed by Brehm as *kwikwikwik*, the sound of which is quite sufficient to set all the male Cuckoos within hearing cuckoo-ing with might and main. Thus it happened to the writer, on a still, quiet evening in spring a few years ago, to be fishing beneath a large elm-tree on the river Thames, when a female Cuckoo flew into the topmost boughs and uttered her peculiar note. From four different points of the compass she was answered by male birds, who one and all directed their flight toward the tree where she was perched. A tremendous scrimmage ensued, and apparently a fight took place, but, being suddenly alarmed, they all took flight in different directions. It is certain that during the breeding season the Cuckoo is a very passionate bird, and loves to call until, from sheer hoarseness, he is obliged to stop; sometimes his cry comes from the middle of a thickly-wooded tree, at other times he will sit on a bare dead branch, or swing in the breeze from the top of a fir-tree. The female bird is more retiring and keeps nearer the ground, so that it is possible to shoot her by hiding behind a tree as she hunts after insects near one of their favourite haunts. The same plurality of males has been observed by the author during the spring at Avington Park, in Hampshire; and on one occasion, when the female was shot, the note of the males was scarcely heard again, as if they had disappeared from the vicinity.

Brehm remarks:* "The note itself, and the manner in which it is emitted, are typical of the bird's habits and character. The same abruptness, insatiability, eagerness, the same rage, are noticeable in its whole conduct. The Cuckoo is a greedy feeder, and a discontented, ill-conditioned, passionate fellow: in short, a decidedly unamiable bird. Its food consists entirely of insects and their larvæ; young Cuckoos, alone, will sometimes eat berries; Cockchafers, Fern-beetles, Moths, and Dragon-flies are favourite morsels, and Caterpillars (especially the hairy species, which no other birds ever devour) being preferred. The hairs of these creatures cling so close to the inner membranes of the stomach that the use of the magnifying glass is necessary to convince one that they do not form part and parcel of that organ. Its keen sight enables the Cuckoo to see Caterpillars from a great distance,

* "Bird-life," p. 593.

when it flies quickly to the spot, seizes them, and returns to its perch, without spending much time over the operation or climbing about after them. The bird is so constantly on the move that it always manages to obtain sufficient food—which is saying a great deal, for its stomach is large and its powers of digestion almost unlimited. Thus it would be a most useful bird, did it not cause so much damage while breeding."

The Cuckoo resembles a Hawk so much in flight that even a practised eye sometimes fails to distinguish it from a Kestrel at first sight. There is, however, a certain pointed look about the body

GREAT SPOTTED CUCKOO.

of the bird which distinguishes it from a Hawk; if near enough, the flat, obtuse head of the latter making the bird appear as if it had no head at all.

Lastly, one word as to the winter home of the Cuckoo. It is always known in England as the "harbinger of spring," and with the exception of the Swift, who very rarely makes a mistake in the period of his advent, there is no bird whose arrival may be considered so certain a sign of that genial season of the year. Just as the Swifts, however, sometimes come in for some cold weather, which proves fatal to many of them, so the Cuckoos have been known to have been detained by cold winds in the south of England, where they have remained in flocks until the weather was more seasonable and they could distribute themselves over the country. They are seldom heard of in the height of summer; and, as the old rhyme says, "in June he changes his tune, in August go he must." And it seems certain that this bird leaves England early in that month, but not entirely, as young birds—perhaps the later offspring—are seen as late as September. The old ones arrive in Egypt on their way south before the young birds, which are somewhat later; and in Berkshire the writer shot three young Cuckoos during the first week in August, a few years ago, out of a flock of birds on migration, which, like himself, had apparently taken shelter under a wood from an approaching thunderstorm. These specimens are now in the British Museum, and are of slightly different ages.

The Cuckoo is a well-known bird at the Cape of Good Hope during the English winter, and specimens are in the national collection. It is much rarer on the west coast of Africa, but was shot by Governor Ussher near Cape Coast Castle, evidently on migration. The main route of the birds visiting the Cape in winter is, however, evidently down the Nile Valley and along the east coast to the Cape Colony and South Africa generally. A second line of migration extends to India, and it probably goes further, and has been found in the island of Celebes. In Asia, however, and Australia, there are several species of Cuckoo, very like the English bird, but smaller and differing in voice, which have not been sufficiently studied to enable one to say whether they are actually distinct or not.

The Cuckoo when adult is ashy-grey, with a white breast, barred across with narrow lines of greyish-black; the tail is long, barred with white on the outer feathers, and spotted with white on the centre ones; the bill is black, with a little yellow at the gape and at the base of the lower mandible; the feet and the eye are yellow; the length of the bird is about thirteen inches. The female is a trifle smaller, and has the chest slightly tinged with rufous. The young bird is quite different, being blackish, mottled with yellow and grey, and having a good deal of white about the hind neck. Rarely in England, but more often on the Continent, the Cuckoo is red instead of grey, and this is called the "hepatic" plumage. It is found also in Owls, Goatsuckers, and a few other birds, and exists in almost all the true Cuckoos.

THE THIRD FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.

THE HONEY GUIDES (*Indicatoridæ*).

These constitute a small family of Scansorial birds allied to the Cuckoos, and, like the latter, they are parasitic, and lay their eggs in other birds' nests. Eleven species are known, of which eight are peculiar to Africa, one is found in the Himalaya Mountains, one in the Malayan Peninsula, and one in Borneo. The Asiatic members of the group are extremely rare, and our knowledge of the habits of these birds is derived from a study of the African species: so that it is not yet known whether the Asiatic Honey Guides deserve the name of *Indicator*, which is applied to the birds on account of their being "indicators," or "pointers out," of Bees' nests containing honey. Dr. Kirk thus described their habits in the Zambesi district:—"The Honey Guide is found in forests, and often far from water, even during the dry season. On observing a man, it comes fluttering from branch to branch in the neighbouring trees, calling attention. If this be responded to—as the natives do by whistling and starting to their feet—the bird will go in a certain direction, and remain at a little distance, hopping from one tree to another. On being followed, it goes farther; and so it will guide the way to a nest of Bees. When this is reached, it flies about, but no longer guides; and then some knowledge is required to discover the nest, even when pointed out to within a few trees. I have known this bird, if the man, after taking up the direction for a little, then turns away, come back and offer to point out another nest in a different part. But if it does not know of two nests, it will remain behind. The difficulty is that it will

HONEY GUIDE. (*After Keulemans.*)

point to tame Bees in a bark hive as readily as to those in the forest. This is natural, as the Bee is the same; the bark hive—'Musinga,' as it is named—being simply fastened up in a tree, and left for the Bees to come to. The object the bird has in view is clearly the young Bees. It will guide to nests having no honey, and seems equally delighted if the comb containing the grubs be torn out, when it is seen pecking at it." Many of the natives of South Africa believe that the bird will occasionally guide the traveller, through sheer malice, to a Leopard or an Elephant; but on this point there seems some little doubt, to judge from a letter of Mrs. Barber, an accomplished lady and good observer in South Africa:—"What I wrote to you in a former letter is the opinion of many old bee-hunters in this part of the country, who have no faith in the popular belief that leading to the Leopard is done on purpose. My nine brothers, who were all brought up in this country, were all of them great hunters, as well as sportsmen; and during all the years of their experience, while they were living at Thurfield, where Bees' nests were exceedingly plentiful, and where they were constantly in the habit of following these birds, never once did the Honey Guide ever lead them *purposely* to any noxious animal. Many times, in following the bird through dense woods, have they started various kinds of creatures; but if they did not neglect the bird for the purpose of hunting, she would continue her flight towards the Bees' nest, regardless of the startled animals. One of my brothers once, while following a Honey Guide through a dense forest near the Kowie, passed directly through a drove of wild Pigs. They were, of course, more frightened than he was, and rushed about in every direction; but my brother knowing the popular belief, and wishing to test it, took not the slightest notice of the wild Pigs, but passed on, keeping his eye on the bird, who went steadily on her way, until she arrived at the nest she intended to show, regardless of the Pigs. I have other reasons for not believing the story. Why should the Honey Guide waste her time in leading people to Leopards, Jackals, Wolves, and so forth? These creatures are not her natural enemies; she would gain nothing by doing it—no advantage whatever; and I have ever found that in nature there is nothing done in vain, or in an empty, purposeless manner. There is always a reason for the peculiar habits and actions of birds and animals of all kinds; and therefore, why should a bird which does not even rear her own young, and has not the care of a nest, fear or care about these animals? Why should the Honey Guide, unlike all animals, do this thing without any reason for doing it? And again, when the bird has arrived at the nest she intends to show, there is an alteration in the notes of her voice. An old bee-hunter knows this in an instant, and knows when he ought to commence searching for the nest. Now, this alteration never takes place when animals of various kinds are startled in passing through the forest while following the bird. Hence I conclude that she does not intend to show where these creatures are, or the alteration in her voice would take place." Some of the Indicators are not of the same use in guiding to Bees' nests, and are consequently held in less repute. They are all birds of similar coloration, being generally of a dull grey, tinged with yellow or olive, and they vary considerably in size, the larger species, such as *I. major* and *I. sparrmanni*, measuring about eight inches in length; while the smallest species, *I. exilis*, from the Gaboon, does not exceed four inches. Although coming very close to the Cuckoos in the natural classification, the small bill, the thick-set, stout plumage, and the nine primaries in the wing, in addition to their peculiar habits, easily distinguish the Honey Guides as a separate family.

THE FOURTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.
THE PLANTAIN-EATERS (*Musophagidæ*).

These may be called a strictly Ethiopian family of birds, every single member being found in Africa, and nowhere else. They have very much the appearance of game-birds, and are all remarkable for their beautiful crests, which they are able to elevate or depress at will. Although belonging to the Scansorial, or climbing birds, they do not always keep their toes in pairs, but being of a lively disposition they hop continually from bough to bough, and the outer toe is seen as often placed in front with the others as it is directed backwards along with the hind toe. With the exception of the Grey Plantain-eaters, all the other species have beautiful red primaries; and the writer was informed by the late African traveller, Jules Verreaux, that the bird often gets caught in violent showers during the rainy season, when the whole of this brilliant red colour in the wing-feathers gets washed out, and the quills become pinky-white, and after two or three days the colour is renewed, and the wing resumes its former beauty.

THE FIRST SUB-FAMILY OF THE MUSOPHAGIDÆ.—THE MUSOPHAGINÆ, OR TRUE PLANTAIN-EATERS.

THE WHITE-CRESTED PLANTAIN-EATER (*Corythaix musophaga*).

This is perhaps the best known of the whole family of these curious birds, being the commonest species in South Africa, where it is plentiful in the forest districts of the Knysna, and the south coast as far as Natal, and the wooded districts of the Eastern Transvaal. It is known by the name of the Louri, or Lory, and the following brief account of its habits is given by Mr. Layard :*—"The Plantain-eater feeds on fruits, and frequents the highest trees, rarely, if ever, descending to the ground, over which it can, however, travel with great rapidity if brought down by a shot. The motions of

WHITE-CRESTED PLANTAIN-EATER.

this species are very graceful and light, and performed with an ease and rapidity that delight the eye of the beholder. Strange to say, though we inquired carefully, we never could obtain any information respecting the nidification of this beautiful and common bird. Mr. Atmore, however, states that the eggs are white; but this must be from hearsay, as he writes: 'How difficult it is to find these forest birds' nests! The Lories are breeding now, but for the life of me I cannot find a nest. The young ones go in troops, and are delicious eating; the old ones in pairs. We never shoot specimens out of a troop except for the pot.' An old forester told him that the eggs were white, both the latter and the nests being like those of Pigeons. Mr. Rickard says: 'I once found an egg in a bird I shot at East London (January 27th); it was pure white, and the size of a tame Pigeon's.' Mr. Bowker writes: 'I once found a Louri's nest. It was just like a Dove's, built of sticks laid horizontally, and about the size of a large dinner-plate, placed about ten feet from the ground in the centre of a round bush. The old bird flew out as I walked up. I found five young birds in the nest; they were almost full-grown, but their tails rather short and stumpy, crest just showing, but I cannot remember whether the red on the wing was showing or not. On my getting up to the nest they all

* Sharpe's edition of Layard's "Birds of South Africa," p. 141.

flew out, and were killed by my Dogs before I could come to the rescue. The bush was twenty or thirty yards from the edge of a large forest, and I was rather surprised at this nest, as I had been told they built in hollow trees.' " In size this species is about nineteen inches long; the general colour is green, with a broad white tip to the feathers of the crest, the abdomen and vent are blackish, the quills brilliant carmine.

The false Touracoes, as Dr. Sclater calls them, do not possess the red colouring of the wings, but are for the most part of a uniform grey colour. The best known species is

THE GREY PLANTAIN-EATER (*Schizorhis concolor*).

This is also found in South Africa, but in different districts to the White-crested Plantain-eater. Where the range of the latter ceases that of the present bird begins, and it is found throughout the Matabele country and the Transvaal as far as the Zambesi, and westwards through Damara Land to Angola. Mr. Andersson writes:—"It is partial to localities abounding in large trees; and when prominently perched, with crest erect, it is not unlike a gigantic Coly. It also climbs and flies like the Colies, which it strongly resembles in its general habits. It is usually found in small flocks, and feeds on berries and seeds, especially those of mistletoe and of other parasitical plants, and also on fruits, young shoots, and insects. The Damaras call this species 'Ongoro-oroquena,' from the extraordinary and almost human cry with which it frequently startles the traveller who is passing near its perch. It is sometimes very easy to approach these birds, whilst at other times they are so shy that they will defy the utmost exertions which may be made to obtain them. On January 5th, 1867, I obtained three eggs of this species, of a dull bluish-white colour, at Omapja, from a boy, who told me that the nest which contained them was composed of sticks roughly put together, and situated in a tree at some distance from the ground; and on March 1st I met with a nest in Ondonga placed in a tree, but at no great elevation, which also contained three eggs, much incubated." Dr. Exton, also, who has been through the Matabele country, writes as follows:—"In travelling through the Bechuana country one often comes upon a party of five or six of these birds, hiding from the mid-day heats under the sheltered portions of dense foliage near the centre of a large tree. Whilst yet undisturbed, the crest lies flat on the head, and can only be seen as a tuft projecting from the occiput. But their first act on becoming aware of an intruder is to run along the branches, either to the summit of the tree or to the extremity of a branch commanding a good look-out, where, with crest fully erected and well thrown forward, they keep up a constant reiteration of their note. If but little alarmed they move rapidly from branch to branch, frequently jerking up the crest, and assuming an attitude of attention. Again, after flight from one tree to another, on alighting, they first rest on a branch, with the body somewhat horizontal and the tail drawn nearly to the perpendicular, as if assuring themselves of their equilibrium, and then raising the body, elongating their neck, and at the same time elevating the crest, they seem to take an observation as to the security of their new position. So much is this a habit of the bird, that during the conversational difficulties of my earlier intercourse with the Bechuanas, when inquiring for the nest of Schizorhis (the native name of which is 'Ma-quaai'), as soon as it dawned upon the mind of a native what bird I meant he has imitated its note, accompanied by a sudden jerking up of the hand, with his fingers extended to the utmost, as if at the same time to mimic the elevation of the crest. Dr. Sclater mentions that 'Mr. J. J. Monteiro, speaking of the Grey False Touraco (*S. concolor*), as observed in Benguella, expressly states that the crest-feathers are always carried erect.' In my own experience, the observation of Schizorhis was an every-day occurrence; and, as I have stated, when undisturbed (also when in flight) very little of the crest is to be seen, but is invariably carried erect on the least alarm. I may here mention a peculiar scream of *S. concolor*. I was one day walking along a low ridge of rocks, from which I flushed an Owl—the common *Bubo maculosus*—that flew to some distance to a clump of trees. Presently I heard an agonised scream, such as is made by a young Antelope when seized by a Dog; and so exact a repetition of the sound was it that even my Dogs were deceived by it, and rushed off in the direction whence it came. I also sent a Kaffir boy, and presently followed myself, when I discovered it was the frightful scream of *Schizorhis*, of which a party were collected round the Owl I had previously disturbed, and whose presence appeared to be the exciting cause. At a later period I had a second opportunity of verifying this observation."

COLIES.

THE SECOND SUB-FAMILY OF THE MUSOPHAGIDÆ.—THE COLIINÆ, OR COLIES.

Like the foregoing sub-family, the Colies are confined to Africa. They have decided affinities with the true Plantain-eaters, but are distinguished at a glance by their long tails, the feathers of which are much pointed, and become smaller and narrower towards the outside of the tail. They are most dexterous climbers, as was well seen in the captive specimens of the Chestnut-backed Coly, which were brought by Cameron from Angola, and lived for some time in the London Zoological Gardens.

THE WHITE-BACKED COLY (*Colius capensis*).

The Colies are known in the Cape Colony by the name of *Muisvogel*, or Mouse-bird, and they are not uncommon, ranging about in small families of from six to eight individuals. Mr. Layard says that they fly with a rapid, though laboured flight, generally at a lower level than the object at which they aim, and on nearing the latter they rise upwards with a sudden, abrupt curve. They creep among the branches like Parrots, and hang suspended head downwards, without inconvenience; and it is said that they invariably sleep in this position, many of them congregated in a ball. The nest was found by Mr. Andersson in Damara Land, between September and December. It was placed in a small bush, and was composed externally of grass and twigs, lined internally with softer grass, and the eggs were dull white, and, according to his observations, always three in number. Mr. Andersson states that the bird "is gregarious in its habits, being found in flocks by day, and also when roosting at night. Its flight is short and feeble, seldom extending beyond the nearest bush or tree, on reaching which it usually perches on one of the lower branches, and then gradually glides and creeps upwards through the foliage, using both bill and feet for that purpose. It is essentially a fruit-eating bird, but I believe when hard pressed for its regular food it does not despise insects and the young shoots of plants. Its flesh is palatable." The Colies as a rule are dull-coloured brown birds, but they have a long crest. The present species is perhaps the handsomest, being ash-coloured, and having the lower back and rump purple glossed with red, while a white line, bordered on each side by a broad black one, extends from beneath the shoulders to the rump. The bill is bluish-white, and the feet bright red. The length of the bird is thirteen or fourteen inches

THE FIFTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.—THE WOODPECKERS (*Picidæ*).

These are perhaps the most typical of all the yoke-footed or climbing birds, as they are most expert climbers, being aided in the latter operation not only by their long toes, which are arranged as usual in this order in pairs, but by their stiffened tail, which enables them to climb with great rapidity up the perpendicular trunks of trees. If they wish to descend a little way they do not turn and come down head-foremost, as a Nuthatch would do, but they let themselves down by a few jerks, still keeping an oblique position, with the tail downwards. The bill in almost every member of the family is wedge-shaped, and very powerful, and with this organ a Woodpecker taps vigorously at the bark, which he sometimes also prises off to get at the grubs or insects underneath. These latter, as they endeavour to escape, have little chance against the intruder, who, in addition to the stout bill which discloses their place of concealment, possesses a peculiar tongue, which is capable of being protruded to a long distance, is furnished with minute barbs at the end, and is covered with a glutinous fluid from which the insects are unable to free themselves. The Woodpeckers nearly all procure their food in the above manner, but occasionally frequent the ground, and the Green Woodpecker (*Gecinus* * *viridis*) commits great ravages among ant-hills. The resting-place is generally a hole excavated by the bird itself in a hollow tree, and the eggs are white. Among the most aberrant of the Woodpecker family are the Wrynecks (*Iynx*†), of which one species is well known in England under the name of the "Cuckoo's mate." The Wrynecks are all birds of beautiful mottled plumage, and do not have a stiffened tail like a true Woodpecker. They are found in Europe, in India, North-Eastern and Southern Africa. Woodpeckers, on the other hand, are extremely plentiful in the New World, and are distributed all over Africa, Europe, and Asia, but are not found in the Australian region, no Woodpecker occurring beyond the Island of Celebes in the Moluccas.

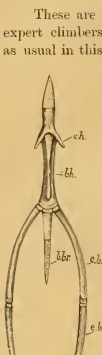


Fig. 1.—"HYOID" BONE OF ADULT FOWL.
(*After W. K. Parker.*)
(*ch*) Cerato-hyals; (*th*) the so-called Besi-hyal; (*b.br*) Besi-branchials, or Uro-hyal; (*c.br, e.br*) together form the thyro-hyal.

One great peculiarity in the anatomy of the Woodpeckers is the structure of the tongue, and its relation to the hyoid bone and its horns, or cornua. (For a description of this part in the Mammalia, see Vol. I., p. 168.) In Birds the hyoid bone is a much more complex structure than in the Mammalia. Besides forming the basis of the otherwise mainly muscular substance of the tongue, it is continued backwards in most birds as a double chain of bones, each pair of which bears a separate name significant of its importance; and the whole is apparently quite distinct from the skull above and from the larynx below. Its composition in the common fowl is best rendered intelligible by reference to the accompanying woodcut (Fig. 1). It represents the entire hyoid apparatus divested of all muscular and other surrounding tissues. The upper part of the figure is that nearest to the tip of the tongue, and the references to the lettering become clear in the course of the subsequent description.

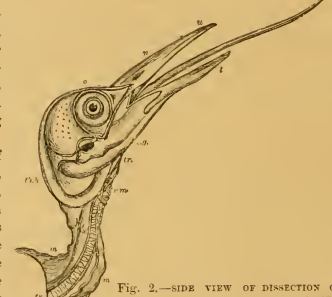


Fig. 2.—SIDE VIEW OF DISSECTION OF HEAD OF COMMON GREEN WOODPECKER.
(*Half natural size. After Macgillivray.*)
(*m, l*) Upper and Lower Mandibles; (*t*) Barbed Tip of Tongue; (*th, ch*) Thyro-hyal Bone of Right Side, with its Muscle and Sheath; (*o*) Right Orbit; (*n*) Right Nostril; (*s.g.*) Right Salivary Gland; (*m, m*) Muscles of Neck; (*tr*) Œsophagus; (*tr*) Trachea; (*r.m.*) Retractor Muscles of Tongue wound round Trachea.

Another woodcut (Fig. 2) shows a side view of a dissection of the head of the common Green Wood-

* γῆ, earth, and κινέω, I shake; *viridis*, green.

† The classical Greek name, from its double note sounding like the exclamation ἰύ, hence the verb ἰύζω, I cry out.

pecker (*Gecinus viridis*), and a reference to the explanation of the lettering on it will give a general idea of the whole.

The tip of the tongue (*t*) is a slender, flattened, horny point, bearing on its sides and upper surface a number of very delicate bristles, or prickles, directed backwards, an arrangement eminently useful to the bird for enabling it to extract its insect food from the recesses to which its beak, by reason of its size and hardness, could not readily, nor with sufficient quickness, gain access. This tip is further rendered a more efficient instrument for this purpose by its being constantly moistened by a very viscid saliva secreted by two particularly large salivary glands (Figs. 2, 3, and 4, *s.g.*); and it was long ago remarked by Sir Charles Bell, in his essay on "The Hand" (Bridgewater Treatise, 1837), that the same muscles that effected the protrusion of the tongue exerted a simultaneous pressure upon these glands, so that the first result of the muscular contraction is to lubricate the tongue, while the rest of its force is spent in shooting it out with marvellous rapidity.

Behind this barbed and horny tip, the tongue is a slender worm-like body, of which the core is the anterior prolongation of the hyoid bone. The fore-part of this core, more like a bristle than a bone, is known to anatomists as the "glosso-hyal," and is immediately succeeded posteriorly by the "cerato-hyal."* Behind this is the "basi-hyal" (Fig. 1, *b.h.*), the last bone to enter into the formation of the tongue proper. From this basi-hyal springs the pair of bones – the "thyro-hyals"—which attain the remarkable degree of development for which the birds now under consideration are distinguished. From each side of the hinder portion, then, of this basi-hyal bone diverge these important "thyro-hyals" (Fig. 1, *c.br.*, *e.br.*). They, in the Woodpeckers (compare Fig. 3, *th.h.*), extend outwards and backwards to pass one on each side of the neck until they curl upwards and forwards, converging to meet one another on the upper part of the back of the head; thence they run along together, ploughing themselves a furrow in the skull-top till they reach almost to the right nostril. Each of these curved and highly elastic bones is surrounded by a delicate sheath, whose inner surface is kept constantly moist and lubricated by its own secretion; and this sheath is attached to the bone of the skull at its junction with the upper mandible, as is shown in the accompanying woodcut (Fig. 3, *i*).

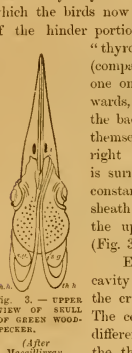


Fig. 3. — UPPER VIEW OF SKULL OF GREEN WOODPECKER.

(*After Macgillivray.*)

(*th.h*,*th.h*) Thyro-hyal Bones; (*i*) Point of their insertion; (*s.g.*) Salivary Glands.

Fig. 4.—DISSECTION OF HEAD OF GREEN WOODPECKER VIEWED FROM BELOW.

(*After Macgillivray.*)

(*b*) Lower Mandible; (*t*) Base of Tongue; (*th.h*, *th.h*) Thyro-hyals; (*s.g*, *s.g.*) Salivary Glands; (*m*, *m*) Muscles of Neck; (*œ*, *œ*) Œsophagus; (*tr*) Trachea; (*e.m*., *e.m*.) Extruser Muscles, which thrust out the Tongue; (*r m.*) Retractor Muscles of Tongue wound round Trachea; (*c.br*., *c.br*.) Cerato-tracheal Muscles binding Trachea to Shoulder-girdle.

Enclosed in the sheath here spoken of, and along the concavity of each bone, is a muscle which has a fixed attachment to the crura of the lower mandible on each side (Fig. 4, *e.m.*, *e.m.*). The contraction of this muscle shoots the tongue out in two different ways. In the Green Woodpecker the extremities of the thyro-hyal bones are themselves attached to the mandible, while the curvature of the bones makes a loop that hangs low down on each side of the neck (see Fig. 2, *th.h.*). As the muscle is shortened this loop is raised up, and the free tip of the tongue is consequently projected; and since the muscle is on the inner, or concave, side of the curve, a very small shortening on its part makes a great addition to the apparent length of the tongue. Sir Charles Bell elucidates this action by comparing the great effect on the curve of a fishing-rod's flexible top that a small tightening of the line has. But while this is the case in many species, there are others in which the sheath alone is attached to the bones of the forehead, and the bones themselves slide along inside together with the contracting fibres of the muscle, thus producing the same result as was obtained in the other case by the loops hanging low down in the neck.

* Compare Fig. 1, *ch.*; this bone usually exists in a paired condition, but in Woodpeckers and some other birds it appears single by the confluence of its members In many birds the "basi-hyal" is succeeded by the "uro-hyal" (Fig. 1, *b. br.*), a bone altogether absent whenever the tongue is capable of extraordinary protrusion.

The tongue, whose length is thus so extraordinarily increased, is drawn back to its original position within the bill by another pair of muscles, one on each side, which are attached to the basi-hyal. These take their origin from the trachea, around which (as shown in Figs. 2 and 4, *r.m.*), in many species, they are curiously wound in their course. And, since the bones are at the point of their greatest curvature when at rest, it is obvious that this action of withdrawal is materially assisted by the elasticity of the prolongations of the hyoid bones themselves; for it is a well-known law that Nature never lets power run to waste, but always utilises forces of mere elasticity or rigidity when by their means the expenditure of nervous energy and muscular contractility can be saved.

It may be observed that this curious development of the bones of the tongue is not confined to the Woodpeckers; in the Sun Birds (*Nectariniidæ*) of the Old World, and the Humming-Birds

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(*Trochilidæ*) of the New, this same adaptation of means to ends obtains. Even in the Picidæ themselves many variations have been noticed, in addition to those above alluded to; for instance, in the Yellow-billed Woodpecker (*Sphyrapicus* varius*) of North America the horns of the hyoid do not reach so far as the eye, so that the tongue, with its bushy tip in this case, is only extensible in a very slight degree; while in the Hairy Woodpecker (*Picus villosus*) the thyro-hyals curve spirally over the right orbit so as to reach entirely around the eye, to be inserted at its lower posterior margin.

Considerable difference of opinion exists as to the damage done by Woodpeckers in tapping sound trees, and many a poor bird pays the penalty of his life for his supposed destructive propensities. Mr. Waterton argues strongly on the side of the bird, and alleges that only rotten and unsound trees are attacked for the sake of a nesting habitation, or for the purpose of getting insects; but that this is not always the case was proved by the writer himself in the spring of 1878, when a boy was sent up to a hole in a beech-tree in Avington Park, in Hampshire. The tree was still

* σφῦρα, a hammer; *picus*, a woodpecker.

GREAT BLACK WOODPECKER AND GREAT SPOTTED WOODPECKER.

perfectly sound, so sound, indeed, that the bird had evidently given up the idea of inhabiting it for that year, and had betaken himself elsewhere, after having excavated a round hole to the depth of two or three inches. In the same tree, a little lower down, was a similar hole, evidently made the previous year, when the bird had "tapped" the tree, and it was clear that he had returned again in the succeeding season, and had tried a little higher up in the trunk, to see if there were any chance of procuring a domicile. This proceeding must have injured the tree, and was the work of a Green Woodpecker, or Yaffle, whose laughing note was heard from another quarter of the park, even as the above examination was being conducted. In this part of Hampshire, though the bird is not persecuted by the owner of Avington, Mr. Edward Shelley, or by his keepers, the Green Woodpecker is rare; but in certain parts of Huntingdonshire the writer can remember to have found it

GREEN WOODPECKER.

very plentiful in his school-days, and it was a never-failing object in a country walk, flitting from tree to tree in front of the observer, and always keeping a sharp look-out from the opposite side of the trunk on which he settled. This species appears in old pieces of poetry under the various names of Yaffle, Woodwele, or Woodwale, Whetile, and it is in some places called "Hewhole," Woodhacker, &c.*:—

"The Skylark in ecstasy sang from a cloud,
And Chanticleer crowed, and the Yaffil laughed loud."
The Peacock at Home.

"The Woodwele sang, and would not cease,
Sitting upon the spray;
So loud he wakened Robin Hood
In the greenwood where he lay."
Ritson's Edition of *Robin Hood*, vol. i., p. 115.

* Yarrell. "British Birds," vol. ii., p. 137.

"There the Jay and the Throstell
The Mavis menyd in her song,
The Woodwale fard or beryd as a bell
That wode about me rung."
True Thomas.

Some Woodpeckers seem to make storehouses against the winter, by pecking holes in a tree, and an interesting example of a piece of bark, in which a Red-headed Woodpecker (*Melanerpes formicivorus*)* had placed a store of acorns, is to be seen in the British Museum.

Another British species, the Lesser Spotted Woodpecker (*Picus*† *minor*), is a bird of different habits, frequenting fruit-gardens in the autumn, and doing very little damage to trees in the nesting season. It generally selects the rotten branch of an old poplar-tree, and hollows out a hole in so perilous a situation that it is difficult to climb to, and, indeed, the whole bough is often brought down by the first gale in the ensuing winter. Here its small wedge-shaped bill speedily makes an excavation, and at some little distance down in the hollow interior it lays its glossy white eggs on the touchwood and decaying wood. Both sexes assist in the preparation of the nest; and in mild winters they sometimes begin with the commencement of the year to look out for their future home. The selection of this appears to be a matter of no small anxiety, for several trees are examined in turn, and often at long distances apart. The birds at the time of incubation keep up a continual signalling one to the other, which is produced by a rapid whirring noise caused by tapping on the thinner branches of the dead trees. This call-note, if it may be called such, is generally heard in the early morning, and ceases as soon as the nesting operations have finally commenced. Besides this note, they have also one like the "laugh" of the Green Woodpecker, but, of course, much reduced in accordance with the difference in the size of the two birds. The little Spotted Woodpecker may often be seen hanging on to, and climbing round, the slender twigs of the outer branches of a tree, and looks much like a Creeper or a Nuthatch, which it does not greatly exceed in dimensions.

THE SIXTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.

THE TOUCANS (*Rhamphastidæ*).‡

The Toucans, with their clumsy bills, have much the aspect of Hornbills, which they may be said to represent in South America, to which continent they are entirely confined, but by this time the student knows that they have really little to do with each other, beyond a certain outward similarity, as the Toucans belong to the Scansorial, the Hornbills to the Fissirostral, section of the *Picariæ*. It is not possible to give a long account of the habits of individual species of Toucans, and a general sketch of their manners and customs is extracted from the monograph of the Toucans written by Mr. John Gould.§ To him the late Prince Maximilian, of Neuwied, an excellent observer, during his travels in South America writes:—"The *Rhamphastidæ* are very common in all parts of the extensive forests of the Brazils, and are killed in great numbers at the cooler portion of the year, for the purposes of the table. To the stranger they are of even greater interest than to the natives, from their remarkable form, and from the rich and strongly-contrasted style of their colouring, their black or green bodies being adorned with markings of the most brilliant hues—red, orange, blue and white—the naked parts of the body dyed with brilliant colours, the legs blue or green, the irides blue, yellow, &c., and the large bill of a different colour in every species, and in many instances very gaily marked. The colouring of the soft parts is, however, so evanescent, that, to determine the species with accuracy, they must be depicted during life or immediately after the birds are killed. Common as these birds are in their native wilds, it is exceedingly difficult to detect their breeding-places; it is certain that they deposit their eggs in the hollow limbs and holes of the colossal trees so abundant in the tropical forests, but I never was so fortunate as to discover them. The stomachs of the specimens I examined contained nothing but the remains of fruits, principally of the softer kinds, for which, indeed, they have such a liking that they resort in great numbers to the plantations in the vicinity of their native haunts, and commit sad havoc among their favourite delicacies. I was informed that they frequently steal and eat young birds, but no instance of their doing so came under my own observation, and I never

* μέλας, black; ἔρπω, I creep; *formicivorus*, ant-eating. † Linnæus. A proper name. ‡ From ῥάμφος, a bill.
§ "Monograph of the *Rhamphastidæ*, or Family of Toucans," by John Gould, F.R.S. Introduction.

detected the remains of animal food in their stomachs. Mr. Waterton's opinion agrees with mine, that they feed solely upon fruits; but Azara, among others, states that they also feed upon animal substances. The specimens we saw in a state of domestication were very voracious and perfectly omnivorous, but they seem to be purely frugivorous in a state of nature, a fact which was, indeed, confirmed by the Brazilian natives whom we questioned on the subject. In their manners the *Rhamphastidæ* offer some resemblance to the Crows, and especially to the Magpies; like them they are very troublesome to the birds of prey, particularly to the Owls, whom they surround and annoy by making a great noise, all the while jerking their tails upwards and downwards. The flight of these birds is easy and graceful, and they sweep with facility over the loftiest trees of their native forests, their strangely-developed bills, contrary to expectation, being no encumbrance to them. The voice of the Toucans is short and unmelodious, and is somewhat different in every species. The feathers are used by the Indians for personal decoration, especially the yellow breasts of the birds, which they affix to their heads on each side near the temple, and also to the ends of their bows."

Mr. Waterton, in one of his Essays, has the following remarks:—"There are three species of Toucan in Demerara, and three diminutives, which may be called Toucanets. The largest of the former frequents the mangrove-trees on the sea-coast. It is never seen in the interior until you reach Macoushia, where it is found in the neighbourhood of the river Tacatou; the other two species are very common. They feed entirely on the fruits of the forest, and, though of the Pie kind, never kill the young of other birds or eat carrion. The larger is called *Bouradi* by the Indians (which means *nose*), the other *Sciron*. They seem partial to each other's company, and often resort to the same feeding tree, and retire to the same shady noon-day retreat. They are very noisy in rainy weather at all hours of the day, and in fair weather at morn and eve. The sound the *Bouradi* makes is like the clear yelping of a puppy-dog, and you fancy he says '*Pia-po-o-co*,' and thus the South American Spaniards call him *Piapoco*. All the Toucanets feed on the same trees on which the Toucan feeds, and every species of this family of enormous bill lays its eggs in the hollow trees. They are social, but not gregarious. You may sometimes see eight or ten in company, and from this you may suppose they are gregarious, but upon a closer examination you find it is only a dinner party, which breaks up and disperses towards roosting-time. You will be at a loss to conjecture for what end Nature has overloaded the head of this bird with such an enormous bill. It cannot be for the offensive, as it has no need to wage war with any of the tribes of animated nature, for its food is fruits and seed, and those are in superabundance throughout the whole year in the regions where the Toucan is found. It cannot be for the defensive, as the Toucan is preyed upon by no bird in South America, and, were it obliged to be at war, the texture of the bill is ill-adapted to give or receive blows, as you will see by dissecting it. The flight of the Toucan is by jerks. In the action of flying it seems incommoded by this huge, disproportionate feature, and the head seems as if bowed down to the earth by it against its will. If the extraordinary size and form of the bill expose the Toucan to ridicule, its colours make it amends. Were a specimen of each species of Toucan presented to you, you would pronounce the bill of the *Bouradi* the most rich and beautiful one. It is worthy of remark that all these brilliant colours of the bill are to be found in the plumage of the body and the bare skin around the eye." Space will not permit of a long extract from the works of d'Azara (the only field naturalist of any fame that Portugal has yet produced), but a few notes of this traveller, made in Paraguay, differ from the foregoing accounts, and show that in the southern portion of their range the habits of some of the Toucans vary to a great extent. So voracious does d'Azara consider them, that on this account he places them among the birds of prey, and writes:—"The Toucans, contrary to all appearances, destroy a great number of birds, and, on account of their long and strong beak, are respected and feared by all species. They attack and drive them from their nests, and in their very presence eat their eggs and young; these they draw from the holes with the long beak, or throw down nest and all together. It is credibly reported that the Toucans do not even respect the eggs or young of the 'Aras' (Macaws) and Caracaras, and if the fledglings are too large or too strong to be lifted from the nest, they dash them to the ground, as if it were their nature not only to devour, but to uselessly destroy. The bird, in flying, presents the point of his bill against the wind, so that it does not offer more resistance than that of other birds in which the head and superficies are equal in extent; besides which, the conformation and specific lightness of this long beak cannot impede flight, because the highest points

of the bird being the bill itself and the anterior portion of the body, they form no obstacle, the wind first taking effect upon the point of the bill. When in a state of repose, the Toucan carries its bill rather more elevated than a horizontal line that would pass through the eyes, and when closely looked at, it looks like a false bill, because its base exceeds the breadth of the head, which presents the appearance of being enclosed in a case. In addition to these singularities, the nostrils are placed behind the aforesaid base. The tongue is very narrow and of an equal thickness throughout. It is entirely osseous, and resembles somewhat a feather two lines in width, furnished with an osseous fringe, which is directed from behind forwards, so that the tongue, stiff and unyielding, takes no part in the direction of the food nor in the formation of the note, which, in the first two Paraguayan species, is confined to the single syllable '*rue*.' The mandibles are very distinctly dentated at their edges, these dentations not corresponding at all above and below, nor are they even relatively symmetrical. The beak itself is a thin osseous sheath, filled with a number of empty cellules. The eye is large, and surrounded by a triangular naked space, puffed up, and very pretty. The foot is very short and stout, and covered nearly to the heel with long scales, harsh to the touch. The outer toe, as well before as behind, is the longest. The claws are much flattened and curved, as in the Woodpeckers. The tail is composed of ten feathers. The Toucan flies at a moderate height, and in a straight horizontal line, flapping its wings occasionally with some noise. The flight is quicker than the smallness of the wings would lead one to believe. It perches towards the top of the highest trees, and though unable to climb after the manner of Woodpeckers, it still progresses with speed, hopping from branch to branch. It pays great attention to all that takes place in its vicinity, advancing with fear and diffidence, like the 'Uruca' and the 'Acahes.' There is no perceptible difference between the two sexes, nor do I believe that the species exists towards the south beyond 28°, nor that it drinks. It rarely settles on the ground. The Toucan hops obliquely and very awkwardly, with the legs separated about a hand's breadth. When it takes young birds from the nest, pieces of meat or fruit, it throws them in the air, as a juggler his balls, and by a quick movement of the beak repeats this action until the food is in a favourable position for being swallowed, and then by another movement gulps it down its large throat. If the

TOUCAN.

mouthful be larger than the orifice of the gullet, the Toucan abandons it without seeking to divide it."

Mr. Bates, in his "Naturalist on the River Amazon," makes some further allusions to the Toucans and their bill, which will be found well worth the reading. He also gives the following history of a tame bird (Vol. ii., p. 341):—

BILL OF TOUCAN.

"One day, whilst walking along the principal pathway in the woods near Ega, I saw one of these Toucans seated gravely on a low branch close to the road, and had no difficulty in seizing it with my hand. It turned out to be a runaway pet bird; no one, however, came to own it, although I kept it in my house for several months. The bird was in a half-starved and sickly condition, but after a few days of good living it recovered health and spirits, and became one of the most amusing pets imaginable. Many excellent accounts of the habits of tame Toucans have been published, and therefore I need not describe them in detail; but I do not recollect to have seen any notice of their intelligence and confiding disposition under domestication, in which qualities my pet seemed to be almost equal to Parrots. I allowed Tocáno to go free about the house, contrary to my usual practice with pet animals. He never, however, mounted my working-table after a smart correction, which he received the first time he did so. He used to sleep on the top of a box in a corner of the room, in the usual position of these birds—namely, with the long tail laid right over on the back and the beak thrust underneath the wing. He ate of everything that we eat (beef, turtle, fish, farina, fruit), and was a constant attendant at our table—a cloth spread on a mat. His appetite was most ravenous, and his powers of digestion quite wonderful. He got to know the meal-hours to a nicety, and we found it very difficult, after the first week or two, to keep him away from the dining room, where he had become very impudent and troublesome. We tried to shut him out by enclosing him in the back yard, which was separated by a high fence from the street on which our front door opened; but he used to climb the fence and hop round by a long circuit to the dining-room, making his appearance with the greatest punctuality as the meal was placed on the table. He acquired the habit afterwards of rambling about the street near our house, and one day he was stolen, so we gave him up for lost. But two days afterwards he stepped through the open doorway at dinner-hour, with his old gait, and sly, magpie-like expression, having escaped from the house where he had been guarded by the person who had stolen him, which was situated at the farther end of the village."

THE SEVENTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.

THE BARBETS (*Capitonidæ*).*

These are climbing birds of somewhat brilliant coloration, distributed over the tropical portions of both hemispheres, but absent in Europe, Northern Asia, Australia, and the Moluccas southwards from the Sunda Islands. "Though strictly arboreal in their habits," write Messrs. Marshall, in their exhaustive work on the family,† "and living only in forest districts or open countries interspersed with groves of trees, they are neither shy nor difficult to approach. When the districts in which they are found happen to be at all thickly populated, the Barbets show no disposition to retreat to more secluded quarters, but take up their abode in gardens, and frequently breed in trees close to the houses. They usually keep to the tops of the trees, but may occasionally be seen creeping among the branches of small bushes and underwood. Their food is fruit, seeds, buds, and occasionally insects; these latter are very seldom resorted to in Asia, more frequently in Africa, and with some American species they form the staple food. They are not gregarious, though a great number may sometimes

* From *Capito*, the principal genus: a proper name.

† "A Monograph of the Capitonidæ, or Scansorial Barbets," by C. H. T. Marshall and G. F. L. Marshall (1871).

be seen together in a fig-tree at the fruit season. They live in pairs during the breeding season, which is in the spring, and commence moulting in September. They rarely, if ever, descend to the ground, and appear to move from tree to tree only when compelled to do so in search of food, or when disturbed by an intruder. Their flight is powerful, but heavy and undulating, like that of a Woodpecker. A curious instance of their disinclination to travel is seen in the fact of the Himalayan Lineated Barbet (*Megalæma hodgsoni*) and the Hoary Jungle Barbet (*M. caniceps*) never crossing the narrow valley of the Deyra Doon, though both are abundant in their respective boundaries; also that the Blue-faced Barbet (*M. asiatica*) is confined to the valley of the Jumna, in the district between Mussooree and Simla, though there are many other valleys apparently equally suitable. When not in pursuit of food, the Barbets sit motionless among the foliage near the tops of the trees, and exhibit none of that vivacity which is so marked a characteristic of the Passerine birds, amongst which they have been sometimes erroneously classed. Their voice is loud and ringing, consisting almost always of one, two, or three syllables, given out with extraordinary power, and may be heard at midday or on a moonlight night when all other sounds are hushed. Some of the American species have, in common with the Toucans, the habit of jerking their tail up over their back when they utter their call. The male and female sometimes keep up what appears to be a 'calling-match' for about ten minutes, and then suddenly cease. As far as is known, they all build in holes of trees, which they make for themselves in soft or decayed branches. No lining is needed for the nest, a few of the broken chips being left at the bottom of a hole. The entrance is circular and neatly bevelled, resembling that of a Woodpecker. The hole is generally about eight or ten inches deep, varying, of course, with the size of the bird. They lay three or four shining white eggs, with rather thin shells, and rather elongated, blunt, oval in shape, both ends being nearly similar. They are laid in the latter end of April and beginning of May in Northern India. Barbets are occasionally caged, but they are very seldom brought to England, and do not bear confinement very well; consequently, little is known of them in this country, except to ornithologists. An interesting account of one of them (*Megalæma zeylanica*) in captivity, by Mr. Layard, will be found quoted below. Their plumage, though very brilliant, is tasteless and too gaudy, and their shape is heavy and ugly, which will account for their skins not yet having been promoted to the positions with which pretty birds' feathers are generally associated in the minds of the non-ornithological public." Mr. Layard's account is as follows:—"The Brown-headed Barbet is common in Ceylon, and universally distributed. It feeds on fruits and berries of all kinds, which it swallows entire. It does not, that I know of, devour

PEARL-SPOTTED BARBET.

small birds when in a state of nature, but one kept in a large aviary at Colombo destroyed all the little *Amadinæ* placed with it. Not content with snapping them up when within his reach, he would lie in wait for them behind a thick bush or the feeding-trough, pounce upon them unawares, and, after beating them a little on the ground or perch, swallow them whole. When this cannibal came into my possession he was confined in a smaller cage than that in which he had at first been secured. This seemed to displease him, and he went to work to find some means of escape. He narrowly examined every side and corner to discover a weak spot, and having detected one, applied himself vigorously to bore a hole through it, as a Woodpecker would have done. Grasping the bars with his feet, he swung himself round, bringing his whole weight to bear upon his bill, which he used as a pickaxe, till the house resounded with his rapid and well-aimed blows. On being checked from exercising his ingenuity in this manner, he became sulky, and refused to eat or offer his call of recognition when I approached him. In a day or two, however, he apparently thought better of the matter, resumed his labours upon another spot, and fed as voraciously as ever, devouring huge slices of bananas, jungle fruits, the bodies of any small birds I skinned, &c."

THE SECOND ORDER.—PICARIAN BIRDS. SUB-ORDER II.—FISSIROSTRES.

CHAPTER IX.

THE JACAMARS, PUFF BIRDS, KINGFISHERS, HORNBILLS, AND HOOPOES.

THE JACAMARS—THE PUFF BIRDS—THE KINGFISHERS—Characters—THE COMMON KINGFISHER—Distribution—Its Cry—Habits—After its Prey—Its own Nest-builder—Mr. Rowley's Note on the Subject—Nest in the British Museum—Superstitions concerning the Kingfisher—Colour—Various Species—CRESTED KINGFISHER—PIED KINGFISHER—Dr. Von Heuglin's Account of its Habits—New World Representatives—OMNIVOROUS KINGFISHERS—THE AUSTRALIAN CINNAMON-BREASTED KINGFISHER—Macgillivray's Account of its Habits—THE LAUGHING JACKASS of Australia—Its Discordant Laugh—The "Bushman's Clock"—Colour—Habits—THE HORNBILLS—Character—Their Heavy Flight—Noise produced when on the Wing—Food—Extraordinary Habit of Imprisoning the Female—Native Testimony—Exception—Fed by the Male Bird—Dr. Livingstone's Observations on the point, and Mr. Bartlett's Remarks—Strange Gizzard Sacs—Dr. Murie's Remarks—Mr. Wallace's Description of the Habits of the Hornbills—Capture of a Young One in Sumatra—THE GROUND HORNBILLS—South African Species—Kaffir Superstition regarding it—Habits—Mr. Ayres' Account of the Natal Species—How it Kills Snakes—The Call—Habits—Mr. Monteiro's Description of the Angola Form—Turkey-like Manner—Wariness—Food—THE HOOPOES—Appearance—Distribution—THE COMMON HOOPOE—Habits—The Name—How does it Produce its Note?—THE WOOD HOOPOES—Habits.

THE FIRST FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

THE JACAMARS (*Galbulidæ*).*

THESE birds are usually of metallic green plumage, with long beaks and wedge-shaped tails, and are found only in Central and Southern America, where they seem to represent the Bee-eaters of the Old World. Not many notices have appeared of their habits, the best being that given by Mr. Waterton, in his "Wanderings" in Demerara:—"A bird called Jacamar is often taken for a Kingfisher, but it has no relationship to that tribe: it frequently sits in the trees over the water, and as its beak bears some resemblance to that of the Kingfisher, this may probably account for its being taken for one. It feeds entirely upon insects. It sits on a branch in motionless expectation, and as soon as a Fly, Butterfly, or Moth passes by, it darts at it, and returns to the branch it had just left. It seems an indolent, sedentary bird, shunning the society of all others in the forest. It never visits the plantations, but is found at all times of the year in the woods. There are four species of Jacamar in Demerara; they are all beautiful, the largest rich and superb in the extreme. Its plumage is of so fine a changing blue and golden green, that it may be ranked with the choicest of the Humming Birds. Nature has denied it a song, but given a costly garment in lieu of it. The smallest species of Jacamar is very common in the dry savannas. The second size, all golden green in the back, must be looked for in the Wallaba Forest; the third is found throughout the whole extent of these wilds; and the fourth, which is the largest, frequents the interior, where you begin to perceive stones in the ground."

* *Galbula*, a proper name.

THE SECOND FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.
THE PUFF BIRDS (*Bucconidæ*).

In general form the Puff Birds are not unlike Kingfishers, some of which they resemble in their habits, feeding chiefly on insects, which they catch in the air. In many respects also they resemble the Bee-eaters (*Meropidæ*), and may be considered as representing the last-named family in South and Central America, to which countries they are entirely confined. Of the Long-winged Puff Birds (*Chelidoptera tenebrosa*) the late Prince Maximilian of Neuwied gives the following account :—"It is not rare in most provinces of South Brazil, and very common in many of them. It is found in certain spots sitting still and immovable upon the high isolated branches of the forest trees. From time to time it flies after an insect in the air, and falls back again to its place like a true Fly-catcher. It is a stupid, still, melancholy bird, but likes to sit high, and not low and near the ground, like other Puff Birds. As in form and colour it rather resembles a Swallow, the Brazilians call it *Anduvinha do mato* (Wood Swallow). The resemblance is greatest when the bird sits upon the ground, for its feet are little adapted for walking, and it consequently shuffles along as a Swallow does. Its flight is light and undulating. Sitting upon a high point, whence it can overlook the neighbourhood, it often emits a short call-note. It is anything but timid, and very easy to shoot. It is usually found where the woods are varied with open country, on the edges of the woods, but likewise in the interior of them. The food of these birds consists of insects, of which I have found the remains in their stomachs. On the Rio Grande del Belmonte I observed how these birds nest. In the month of August I saw them enter a round hole in a perpendicular sand-bank on the river, like a Kingfisher's. After digging about two feet in a horizontal direction, we found two milk-white eggs upon a bad lining of a few feathers." *

THE THIRD FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.
THE KINGFISHERS (*Alcedinidæ*).

The Kingfishers are a very varied family, including within their limits birds of very different form and habits. The bill is always long and powerful for the size of the bird, producing, in some of the smaller species, a top-heavy and ungainly aspect; but this organ is modified according to the habits of the birds, and is strictly in accordance with the functions which it has to perform. The foot is similar in all Kingfishers, the sole being very flat, and the toes joined together for the greater part of their length, so that the birds always have a very firm support to their bodies. The legs are very short and weak, the wings powerful, and the gape very wide. The Kingfishers may be divided into two sub-families, distinguished by the form of the bill, which is long and compressed in the fish-eating Kingfishers (*Alcedininæ*), of which the European bird is a type, with a distinct ridge or keel along the upper mandible; while in the *Dacelonînæ*, which have a stouter and flatter bill, with a smooth and rounded culmen, the food is varied, consisting more of insects than of fish.

THE COMMON KINGFISHER (*Alcedo*† *ispida*).

This is, perhaps, the most brilliantly-coloured bird there is in England, but by reason of its shy habits and wonderfully quick flight it is not often observed, excepting as a flash of bright blue on the river side, appearing for an instant and gone the next. It is, however, by no means uncommon in many of the rivers in the south of England, particularly during the month of October, when a partial migration of the species evidently takes place. At this season of the year, the writer once observed a Kingfisher on the ornamental water in St. James's Park. Beyond the British Islands it is found in most parts of the European continent, being replaced in the East by the little Indian Kingfisher (*A. bengalensis*), a miniature of the English bird, but with a much longer bill. The following account of the habits of this bird, the result of several years' close acquaintance with the species on the river Thames, is taken from the author's work on this subject‡ :—"When in a wild state, flying along the banks of a stream, or sitting patiently at watch for its finny prey, the Kingfisher is a beautiful sight. Often has it been our good fortune to witness the bird at close quarters, but this is by no means easy to

* Selater, "Synopis of the Fissirostral Family Bucconidæ," 8vo, 1854.

† *Alcedo*, a Kingfisher.

‡ Sharpe's "Monograph of the Alcedinidæ, or Kingfishers."

accomplish, owing to the extreme wariness of the bird from repeated persecution. The presence of the Kingfisher in one's neighbourhood can be detected from some distance by the faint cry which falls upon the ear from afar. This note, which is a shrill, but not unmusical, scream, generally consists of two syllables, but is very difficult to render in language. Naumann gives it as *ti-ti*; which is by no means a bad representation of the cry; and these syllables are quickly repeated as the bird leaves its perch and skims over the stream. The flight is rapid and very direct, the bird speeding like a bullet a little height above the surface of the water. When suddenly disturbed, it utters its cry shortly after leaving its perch, and then flies for some distance in silence; but when passing unmolested from one resting-place to another, its shrill note may be heard at frequent intervals. Just before perching, the cry is uttered three or four times successively—*ti-ti-ti-ti*. When resting, it sits uprightly, with the glance directed downwards, motionlessly scanning the stream beneath, intent on the capture of any fish or water insect which may come within its reach. Its unerring dive seldom proves fruitless; and when secured, a few smart raps on its perch, to which the bird always returns, deprive the victim of life, after which it is immediately swallowed. Except in the early morning, it seldom chooses a very open position for its resting-place; but in the autumn, when the migration is in progress, at break of day it is not unusual to see two, or even three, birds in company on a rail or on the side of a punt; in the day-time, however, it loves solitude, and seldom more than one can be seen at once, and then it affects more shady and secluded haunts. In general it is a lonely bird, jealous of intrusion, especially from individuals of its own species. Each pair appears to choose and maintain a particular hunting-ground, and should one Kingfisher enter upon the domain of another, it is speedily and effectually ousted by the rightful owner with cries of rage. So fierce is the animosity displayed by these birds, that when excited in combat they fly heedless of obstacles, and thus occasionally meet their death in their headlong career." An instance is on record of two Kingfishers flying with such violence against a window that both pursuer and pursued met their death on the spot. The present species does not always pounce on its prey from a perch, but will occasionally fly out over the mid-stream, and hover in the air like a Kestrel Hawk; and after making an unsuccessful plunge, will repeat its hovering position over the same spot, until its efforts are rewarded with success. It has been seen also to dash into the water several times in succession, which movement has been supposed to be for the purpose of attracting fish to the spot by disturbing the water; it is, however, more probable that in this exercise the bird is taking a bath. The young have exactly the same cry as their parents, but the note is less shrill. On leaving the nest, they often congregate in some well-shaded locality by the side of the stream, where food is brought to them by their parents, and the presence of the nestlings

COMMON KINGFISHER.

is often betrayed by their shrill pipings. The bill in the young birds is very short, and has a little white tip to it; in the adult male it is entirely black; but the female may always be distinguished by the base of the lower mandible being red.

That the Kingfisher makes its own hole is now an ascertained fact, and the following note on the subject was published in 1866 by Mr. G. Dawson Rowley:—"Though the subject of the Kingfisher (*Alcedo ispida*) is somewhat stale, yet, in consequence of the remarks which I have just read in the October *Quarterly* on 'Homes without Hands,' I send you the following notes, made this spring, in order to set at rest, if possible, a mistake regarding the breeding of this bird. Modern writers on the Kingfisher are hardly more free from error than even Ovid or Pliny. The bird is a true miner, and makes a nest of fish-bones; but, as no rule is without an exception, when it cannot find a suitable bank to bore in, it has been known to nidificate in abnormal situations; and when abundance of proper fish are not to be caught it is obliged to do without bones.

"From many years' constant watching, I can exactly tell the probable position of the hole, and the day it will be begun. Accordingly, on Thursday, March 29, I sent two witnesses to a particular spot on the River Ouse, St. Neots, Huntingdonshire. They observed that there was on that day positively no hole of any kind, no vestige of hole, in that bank. On Easter Monday, April 2, I sent a keeper to the place. He reported the hole as begun. On the same day I went in a boat, and, putting a reed up, found it by actual measurement about fifteen inches deep, the moulds being quite fresh outside. Droppings of the bird (which was seen constantly leaving the hole) were visible in two places. There was also a shallow hole a little to the left of the above-mentioned one. This was a failure—either from caprice or some other cause abandoned. We observe the same in Woodpeckers, which will sometimes bore in three or four places before they get one to their liking, a circumstance I particularly remarked in a pair of the Greater Spotted Woodpeckers (*P. major*) last spring. Between March 29 and April 2 the Kingfisher had made two holes. I thought it best now to leave the place, only receiving from the keeper each morning a report, as he went by in his boat, how the bird was going on.

"Saturday, April 7, I made a memorandum: 'I again observe fresh moulds, but not, as we consider, to-day's, but yesterday's: hence I suppose the hole to be nearly finished, if not quite.' Here, I should say, after taking these nests constantly for nearly thirty years, I find twenty-one days is the correct time, from the commencement of the excavation to the end of laying seven eggs. I never had the luck to find eight; Mr. Gould, however, informs me he once did. 'Saturday, April 21. Opened the hole situated in the perpendicular bank to keep off Water-rats. Found by measurement the entrance was twelve inches from the surface of the ground, and about five feet from the water. The length of the ascending gallery was eight inches and a half, and the oval chamber six inches in diameter more. The top of the chamber was nine inches from the surface of the ground. It contained the usual nest of fish-bones, which was one inch and a half deep; and the same, with the seven fresh eggs, are now before me, with two other nests from the same locality. The bird flew off after the first dig, which I commonly made so as to cover up the hole again without disturbance if the full number of eggs had not been laid. There was no excrement in the chamber, but much just outside in the gallery.' The size of the chamber is just sufficient for the owners to turn round pleasantly. When the young birds, which I have seen in every stage, have been some time in the nest, of course the hole gets very foul. Here, then, is a case, capable of being attested by two or three witnesses step by step—and concerning which there can be no doubt—where the Kingfisher is proved to have made its own hole. I have known it when driven from one bank by floods to revert to an old hole of its own making in the previous year; but never has there been an instance of its taking up with the abode of its most deadly enemy, the Water-rat. It is hard to prove a negative, but it is certainly a most unlikely thing for a Kingfisher to enter a rat-hole. No one who has seen the eggs of this species *in situ* as often as I have can deny that the fish-bones are placed with the design of making a nest."

In the British Museum may be seen a nest of the Kingfisher, which was taken by Mr. Gould under the following circumstances:—"On the 18th of April, 1859, during one of my fishing excursions on the Thames, I saw a hole in a precipitous bank, which I felt assured was the nesting-place of a Kingfisher; and on passing a spare top of my fly rod to the extremity, a distance of nearly

three feet, I brought out some freshly-cast bones of fish, convincing me that I was right in my surmise. The day following I again visited the spot with a spade, and, after removing nearly two feet square of the turf, dug down to the nest without disturbing the passage which led to it. Here I found four eggs placed on the usual layer of fish-bones. These I removed with care, and then replaced the earth, beating it down as hard as the bank itself, and restored the turfy sod. A fortnight after the bird was seen to leave the hole again, and my suspicions were aroused that she had taken to her old breeding quarters a second time. I again visited the place on the twenty-first day from the date of my former exploration, and upon passing the top of my fly rod up the hole, found, not only that it was of the former length, but that the female was within. I then took a large mass of cotton-wool from my collecting-box, and stuffed it to the extremity, in order to preserve the eggs from damage during my again laying it open from above. On removing the sod and digging down as before, I came to the cotton-wool, and beneath it was formed a nest of fish-bones the size of a small saucer, the walls of which were fully half an inch thick, together with eight translucent pinky-white eggs, and the old female herself. This nest I removed with the greatest care; and it is now deposited in the proper place for so interesting an object—the British Museum. This mass of bones, then weighing 700 grains, had been cast up and deposited by the bird and its mate in the short space of twenty-one days. Ornithologists are divided in opinion as to whether the fish-bones are to be considered in the light of a nest. Some are disposed to believe them to be the castings and feeces of the young brood of the year, and that the same hole being frequented for a succession of years, a great mass is at length formed; while others suppose that they are deposited by the parents as a platform for the eggs, constituting, in fact, a nest; and I think, from what I have adduced, we may fairly conclude this is the case: in fact, nothing could be better adapted to defend the eggs from the damp earth." In ancient times there was a legend that when the Kingfishers made their nests—which were supposed to float upon the top of the sea—fine weather was always allowed to prevail.* A custom used formerly to be in vogue in England of turning a Kingfisher into a weathercock; and, according to the late M. Jules Verreaux, this practice is pursued in France even in the present day, where the bird is mummified and suspended by a thread with extended wings in order to show the direction of the wind. Mr. Harting alludes to these superstitions in his "Ornithology of Shakespeare" (p. 275). It was formerly believed that during the time the Halcyon, or Kingfisher, was engaged in hatching her eggs, the water, in kindness to her, remained so smooth and calm that the mariner might venture on the sea with the happy certainty of not being exposed to storms or tempests; this period was therefore called, by Pliny and Aristotle, "the halcyon days."

> "Expect Saint Martin's summer, *halcyon* days."
> *Henry VI.*, Part i., Act i., sc. 2.

It was also supposed that the dead bird, carefully balanced and suspended by a single thread, would always turn its beak towards that point of the compass from which the wind blew. Kent, in *King Lear* (Act ii. sc. 2), speaks of rogues who—

> "Turn their *halcyon* beaks
> With every gale and vary of their masters."

And, after Shakspere, Marlowe, in his *Jew of Malta*, says:—

> "But how now stands the wind?
> Into what corner peers my *halcyon's* bill?"

The Common Kingfisher measures about seven inches from the tip of his bill to the end of his tail. The colour of the upper parts is blue, greener on the mantle and scapulars, and beautiful rich cobalt on the back, rump, and upper tail-coverts; the head is blue, barred with black, the wings blue, with spots of brighter cobalt on the coverts; in front of the eye is a spot of rufous, this being also the colour of the eye-coverts and under parts; the throat is white, and there is a patch of white on each side of the neck; the cheeks and sides of the breast are blue, the bill is black, the feet

* "Perque dies placidos hiberno tempore septem
Incubat alcyone pendentibus æquore nidis."—Ovid, Met. xi. 745.

PIED KINGFISHER.

red. The female is coloured like the male, but can always be told by the red colour at the base of the under mandible. This is also present in young birds of both sexes, but the latter can readily be distinguished by their shorter bills.

Species of the genus *Alcedo* are distributed over the greater part of the Old World, extending even into the Molucca Islands, but in Australia and the Papuan group they are represented by the genus *Alcyone*, comprising Kingfishers of similar form to the English bird, but distinguished by the absence of the inner toe. In Africa and Madagascar some beautiful little crested Kingfishers (*Corythornis*) are met with, the largest of which scarcely exceeds five inches in length. A very familiar species on the banks of the Nile is the Pied Kingfisher (*Ceryle* * *rudis*), one of the commonest birds in Africa and India, and of this species Dr. von Heuglin writes †:—"It lives in pairs, is sociable, and, except during the breeding season, more friendly with members of its own species than other Kingfishers, and often several pairs dwell in the same neighbourhood. It sits and watches along the shore on overhanging branches, on roofs, walls, brickets, rocks, and even on the ground, but seldom pounces from the latter on its prey. From time to time it takes a flight over shallow clear water, also right across the river or from one island to another, sometimes very low, generally, however, several fathoms above the surface. Its flight is not very swift, but straight, and steadied by quick, fluttering motions of the wing—not rushing, like that of *Alcedo ispida*—and it rises and falls according to will and with great agility. One often sees it, after taking a start by several quick flaps of the wing, and gliding on for a distance, suddenly, with one quick movement, alter the direction of the flight and suddenly stop and hover. When hovering, the bill is held straight down, and the hind part of the body and tail also rather lowered. Directly it catches sight of its scaly prey it turns up, lays its feathers close to the body, and drops like a stone into the water, remaining often over ten seconds below the surface. It seldom misses its mark, and devours the fish it has captured either on the wing or at one of its resting-places. The voice is a shrill whistle, at the same time chirpy, or at times snickery. During the pairing time the males often fight on the wing, and roll together, calling loudly, nearly to the surface of the water. In Egypt the breeding season is our spring; according to Adams, as early as December. The nest, consisting of a small heap of clean dry grass, is placed in a horizontal hole about arm's depth in a steep bank, and contains four to six pure white roundish eggs, the shell of which is rather rough compared with that of *Alcedo ispida*. Often several nest-holes are close together. The plumage of the young much resembles that of the adult. There is scarcely any bird on the Nile tamer than the Black and White Kingfisher." The genus *Ceryle*, to which the foregoing species belongs, is largely represented in the New World, one of the best known being the Belted Kingfisher of North America, and an unusual circumstance in fish-eating Kingfishers is characteristic of the genus, viz., a difference in the colouring of the sexes. The Stork-billed Kingfishers (*Pelargopsis*‡) are the most powerful members of the sub-family, some of them measuring nearly a foot and a half in length.

More difference in form and size is perceptible in the omnivorous Kingfishers (*Daceloninæ*), where some of the little three-toed species of *Ceyx* do not exceed five inches in length, whereas the Great Laughing Jackasses of Australia (*Dacelo*) attain the dimensions of more than a foot and a half. The smaller birds of this section feed almost entirely on insects, and the Rose-cheeked Kingfisher of Africa (*Ispidina* § *picta*) feeds principally on Grasshoppers and small Locusts, while its representative in Natal (*I. natalensis*) is said to feed entirely on Butterflies and insects caught on the wing. They are often found along the banks of rivers, but never catch fish. The large genus *Halcyon* is distributed all over Africa, and ranges throughout Southern Asia, through China, to Japan, inhabiting also the islands of the Malay Archipelago and the entire Continent of Australia. These birds prefer a mixed diet, and, in addition to an occasional fish, they will also eat crustacea, small reptiles, and insects. Perhaps the most beautiful of all the Kingfisher family are the *Tanysipteræ*, ‖ which are found only in New Guinea, the adjacent Moluccas, and the north-east peninsula of Australia. These birds have only ten tail-feathers, the middle pair being very much longer than the rest, and ending in a spatule or racket. They live entirely in the forests, feeding on insects, and they are said to roost in the holes of rocks by the side of small streams. The best known species of *Tanysiptera*

* κηρύλος, a sea-bird of the halcyon kind. † "Ornithologie Nord Ost Afrikas," p. 185.
‡ πελαργός, a stork; ὤψ, a face. § Diminutive of *Ispida*, a Kingfisher. ‖ τανύω, to stretch; πτερόν, a wing.

is the Australian Cinnamon-breasted Kingfisher (*T. sylvia*), which was discovered by the late Mr. John Macgillivray, who gives the following account of its habits :—"This pretty *Tanysiptera* is rather plentiful in the neighbourhood of Cape York, where it frequents the dense bushes, and is especially fond of resorting to the sunny openings in the woods, attracted, probably, by the greater abundance of insect food found in such places than elsewhere. I never saw it on the ground, and usually was first made aware of its presence by the glancing of its bright colours as it darted past with a rapid arrow-like flight, and disappeared in an instant amongst the dense foliage. Its cry, which may be

LAUGHING JACKASS.

represented by *whee-whe-whee* and *wheet-wheet-wheet*, is usually uttered when the bird is perched on a bare, transverse branch, or woody, rope-like climber, which it uses as a look-out station, and whence it makes short dashes at any passing insect or small Lizard, generally returning to the same spot. It is a shy, suspicious bird, and one well calculated to try the patience of the shooter, who may follow it for an hour without getting a shot, unless he has as keen an eye as a native, to whom I was indebted for first pointing it out to me. According to the natives, who know it by the name of *Quatawur*, it lays three white eggs in a hole dug by itself in one of the large ant-hills of red clay which form so remarkable a feature in the neighbourhood, some of them being as much as ten feet in height, with numerous buttresses and pinnacles. I believe that the bird also inhabits New Guinea; for at Redscar Bay, on the south-east of that great island, in long. 146° 15′ E., a head strung upon a necklace was procured from the natives."

The largest of all the Kingfishers are the Laughing Jackasses of Australia, this curious name being given to the bird from its strange note and peculiar look, both of which can be appreciated

by any visitor to the London Zoological Gardens, where there is generally one, if not two, out of the seven species known. Of the bird in its native haunts a very good idea is given us by the "Old Bushman," the late Mr. Henry Wheelwright, which is here taken from a little work called the "Bush Wanderings of a Naturalist." "About an hour before sunrise the bushman is awakened by the most discordant sounds, as if a troop of fiends were shouting, whooping, and laughing around him in one wild chorus: this is the morning song of the 'Laughing Jackass,' warning his feathered mates that daybreak is at hand. At noon the same wild laugh is heard, and as the sun sinks into the west it again rings through the forest. I shall never forget the first night I slept in the open bush in this country. It was in the Black Forest. I woke about daybreak, after a confused sleep, and for some minutes I could not remember where I was, such were the extraordinary sounds that greeted my ears; the fiendish laugh of the Jackass, the clear, flute-like note of the Magpie, the hoarse cackle of the Wattle-birds, the jargon of flocks of Leatherheads, and the screaming of thousands of Parrots as they dashed through the forest, all joining chorus, formed one of the most extraordinary concerts I have ever heard, and seemed at the moment to have been got up for the purpose of welcoming the stranger to this land of wonders on that eventful morning. I have heard it hundreds of times since, but never with the same feelings that I listened to it then. The Laughing Jackass is the bushman's clock, and being by no means shy, of a companionable nature, a constant attendant about the bush-tent, and a destroyer of Snakes, is regarded, like the Robin at home, as a sacred bird in the Australian forests. It is an uncouth-looking bird, a huge species of land Kingfisher, nearly the size of a Crow, of a rich chestnut brown and dirty white colour; the wings slightly chequered with light blue, after the manner of the British Jay; the tail-feathers long, rather pointed, and barred with brown. It has the foot of a Kingfisher; a very formidable, long, pointed beak, and a large mouth; it has also a kind of crest, which it erects when angry or frightened, and this gives it a very ferocious appearance. It is a common bird in all the forest throughout the year; breeds in a hole of a tree, and the eggs are white; generally seen in pairs, and by no means shy. Their principal food appears to be small reptiles, grubs, and caterpillars. As I said before, it destroys Snakes. I never but once saw them at this game: a pair of Jackasses had disabled a Carpet-Snake under an old gum-tree, and they sat on a dead branch above it, every now and then darting down and pecking it, and by their antics and chattering seemed to consider it a capital joke. I can't say whether they ate the Snake—I fancy not; at least the only reptiles I have ever found in their stomachs have been small Lizards. The first sight that struck me on landing in London was a poor old Laughing Jackass moped up in a cage in Ratcliffe Highway. I never saw a more miserable, woe-begone object. I quite pitied my poor old friend, as he sat dejected on his perch; and the thought struck me at the time that we were probably neither of us benefited in changing the quiet freedom of the bush for the noise and bustle of the modern Babylon." The Common Laughing Jackass has the sexes alike, but in all the other species the male has a blue tail and the female a red one.

THE FOURTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

THE HORNBILLS (*Bucerotidæ*).

These birds are found in Africa, India, and throughout the Malayan region and Molucca Islands, as far as New Guinea. They are birds of rather ungainly appearance, nearly every species having a casque, or helmet, which is developed in every variety of shape, and in some of them reaches an extraordinary size. The flat soles which were alluded to in the Kingfishers are here developed in a greater degree, and the toes are united together in exactly the same way. The flight, however, of the Hornbills is very different from that of the Kingfishers, being heavy and performed with an abundance of noise: so much so that some explorers in South-eastern New Guinea have been led to speak of a bird whose wings, when flying, produced a noise "resembling a locomotive," but which was doubtless made by the large Hornbill (*Buceros* * *ruficollis*), which frequents that part of the world. They are generally found on very lofty trees and at a great height, which makes them difficult to shoot; and Governor Ussher says that in ascending the lonely forest-clad rivers of North-western Borneo the only sign of life is often a solitary Hornbill flying across at a great height in the air. Wallace states that the Rhinoceros Hornbill (*Buceros rhinoceros*), a native of the Malayan Peninsula and Borneo,

* βούκερως, having the horn (κέρας) of a cow (βοῦς).

finds the exertion of flying so great that it is compelled to rest at intervals of about a mile; and the same author says that he heard the Great Hornbill (*Dichoceros bicornis*) more than a mile off, so that the amazement caused by one of these large birds to the travellers in New Guinea, as mentioned above, does not seem so very inexplicable. The voice of the last-named species is said to be very harsh and grating, and the noise it makes is compared by Wallace to something between the bray of a Jackass and the shriek of a locomotive, and is not to be surpassed, probably, in power by any sound that an animal is capable of making. Tickell says that its roar re-echoes through the hills to such a degree

GREAT HORNBILL.

that it is difficult to assign the noise to a bird; and Wallace observes that this is kept up so continuously as to be absolutely unbearable. The flight is heavy, and performed by repeated flappings of its huge wings. It usually flies in a straight line, and sails only when about to alight upon some tree.*

The food of the Hornbills consists principally of fruits, but under certain circumstances they become to a great extent omnivorous, and will devour anything, some of the species searching the ground for Lizards, which they devour readily, both when wild and in confinement; and the Pied Hornbill (*Anthracoceros malabaricus*) is stated by Mr. Inglis to be very fond of live fish, which it catches in shallow pools. The way he discovered this predilection for an abnormal diet was as follows: he possessed a tame Otter and three tame Hornbills; at feeding time the Otter was placed in a tub

* Elliot: "Monograph of the Bucerotidæ, or family of the Hornbills," Part IV.

containing live fish, and these, when closely pressed, would jump out to escape from their pursuer, and were immediately swallowed by the Hornbills. Mr. Inglis has also found bones of fish in the stomachs of birds which he had shot; and the natives of the Naga Hills affirm that when these Hornbills are intent on fishing they can be approached sufficiently close to be killed by a stick.

By far the most curious habit belonging to these birds is that which takes place during the breeding season, when the male bird plasters the female into a hollow tree, there to hatch her eggs, nor does he release her until the young ones are nearly full grown. It is scarcely possible to conceive a practice more detrimental to the well-being of any bird than this. The exertion of feeding himself as well as his wife and nestlings must entail a serious strain upon the male, while the destruction of the latter must inevitably ensure the starvation of the female and of the young birds. This curious habit has been well attested by observers in Asia as well as in Africa; and the writer once received from an old negro collector on the West Coast of Africa, who rejoiced in the name of St. Thomas David Aubinn, and styled himself "Royal Hunter to the King of Denkera," an adult female of the Black Hornbill (*Sphagolobus atratus*), together with a nearly full-grown young one, which, he said, had been taken by him together out of the hole of a tree; and the habits of the Hornbill in this respect were given by him in the following words: "When the female go to sit, the male he her shut in tree. If he no bring food, then she angry. If he no then bring food, then she more angry—swear. If he no then bring food, then she curse him for die. Man—beef—beefy—beef!"

If the last sentence is intended to represent the enraged Hornbill, it is evident that the noises produced by the bird are not of that startling character ascribed to the Eastern species by Wallace, as mentioned above. All accounts seem to agree that the female is shut in the hollow of a tree; but Dr. Kirk noted an exception, on native authority, and therefore one which must be confirmed by future research. This is the Crested Hornbill (*Bycanistes cristatus*), which is a common bird on the river Shiré, where it goes in large flocks, and roosts regularly in the same places. "The natives say that the female hatches her eggs in a hole underground, in which she is fastened by the male." Our astonishment at the imprisonment of the female Hornbill is not lessened when it is found that the male bird keeps her supplied with food by a most curious process, which accounts for the statement of Dr. Livingstone *:—"The first time I saw this bird was at Kolobeng, where I had gone to the forest for some timber. Standing by a tree, a native looked behind me and exclaimed, 'There is the nest of a Korwe.' I saw a slit only, about half an inch wide and three or four inches long, in a slight hollow of a tree. Thinking the word Korwe denoted some small animal, I waited with interest to see what he would extract. He broke the clay which surrounded the slit, put his arm into the hole, and brought out a Tockus, or Red-beaked Hornbill, which he killed. He informed me that when the female enters her nest she submits to a real confinement. The male plasters up the entrance, leaving only a narrow slit by which to feed his mate, and which exactly suits the form of his beak. The female makes a nest of her own feathers, lays her eggs, hatches them, and remains with the young till they are fully fledged. During all this time, which is stated to be two or three months, the male continues to feed her and the young family. The prisoner generally becomes quite fat, and is esteemed a very dainty morsel by the natives; while the poor slave of a husband gets so lean that on the sudden lowering of the temperature, which sometimes happens after a fall of rain, he is benumbed, falls down, and dies." At a meeting of the Zoological Society on the 25th February, 1869, Mr. A. D. Bartlett produced a curious envelope, which had been thrown by a Wrinkled Hornbill (*Anorrhinus corrugatus*) in the Zoological Gardens of London, which was found to contain plums or grapes well packed together; and Mr. Bartlett came to the conclusion that it was by means of fruit packed together in such a wrapper that the male fed the female during her confinement in the hollow tree. In 1874, Dr. Murie exhibited to the same society some similar envelopes, or, as he more properly called them, gizzard sacs, which had been thrown up by a specimen of Sclater's Hornbill (*Bycanistes subcylindricus*) in the same way as by the previous bird. On examination, these gizzard sacs proved to be the interior lining of the bird's stomach; and it was evident, from the short time that elapsed between the throwing up of the envelopes, that, as Dr. Murie observed, the bird in the interval had made a new one, and got rid of it also, without apparently being any the worse. One can readily imagine, however, that this process, being continued during the long period that the female is shut up in the hole of the tree, must tend

* "Missionary Travels in South Africa."

greatly to weaken the bird. The habit of feeding his mate seems to be inherent in every Hornbill, even in captivity, for Mr. Bartlett observes :—"The tame male Hornbill is particularly distinguished at all seasons by this habit of throwing up his food, which he not only offers to the female, but to the keepers and others who are known to him. The male Concave Hornbill (*Buceros cavatus*) now in the Gardens will frequently throw up grapes, and, holding them in the point of the bill, thrust them into the mouth of the keeper, if he is not on the alert to prevent or avoid this distinguished mark of his kindness."

Mr. Wallace thus describes the habits of the Hornbills, as observed by him during his travels in the East, and he points out certain peculiarities, proving that the old systematic position of these birds near the Toucans of America is erroneous :—"From an examination of the structure of the feet and toes, and from a consideration of their habits, we are led to conclude that the Hornbills are Fissirostral birds, though of a very abnormal form. Their very short legs and united toes, with a broad flat sole, are exactly similar to those of the Kingfishers. They have powerful wings, but their heavy bodies oblige them to use much exertion in flight, which is not therefore very rapid, though often extended to considerable distances. They are (in the Indian Archipelago, at least) entirely frugivorous, and it is curious to observe how their structure modifies their mode of feeding. They are far too heavy to dart after the fruit in the manner of the Trogons; they cannot even fly quickly from branch to branch, picking up a fruit here and a fruit there; neither have they strength or agility enough to venture on the more slender branches with the Pigeons and Barbets; but they alight heavily on a branch of considerable thickness, and then, looking cautiously round them, pick off any fruits that may be within reach, and jerk them down their throats by a motion similar to that used by the Toucans, which has been erroneously described as throwing the fruit up in the air before swallowing it. When they have gathered all within their reach they move sideways along the branch by short jumps, or, rather, a kind of shuffle, and the smaller species even hop across to other branches, when they again gather what is within their reach. When in this way they have progressed as far as the bough will safely carry them, they take a flight to another part of the tree, where they pursue the same course. It thus happens that they soon exhaust all the fruit within their reach; and long after they have left a tree the Barbets and *Eurylaimi* find abundance of food on the slender branches and extreme twigs. We see, therefore, that their very short legs and syndactyle feet remove them completely from the vicinity of the Toucans, in which the legs are actively employed in moving about after their food. Their wings, too, are as powerful as those of the Toucans are weak; and it is only the great weight of their bodies that prevents them from being capable of rapid and extensive flight. As it is, their strength of wing is shown by the great force with which they beat the air, producing a sound, in the larger species, which can be distinctly heard a mile off, and is even louder than that made by the flight of the great Muscovy Duck." Mr. Wallace * also describes the capture of a young Hornbill in Sumatra :—"I returned to Palembang by water, and while staying a day at a village while a boat was being made water-tight, I had the good fortune to obtain a male, female, and young bird of one of the large Hornbills. I had sent my hunters to shoot, and while I was at breakfast they returned, bringing me a fine large male of the *Buceros bicornis*, which one of them assured me he had shot while feeding the female, which was shut up in a hole in a tree. I had often read of this curious habit, and immediately returned to the place, accompanied by several of the natives. After crossing a stream and a bog, we found a large tree leaning over some water, and on its lower side, at a height of about twenty feet, appeared a small hole, and what looked like a quantity of mud, which I was assured had been used in stopping up the large hole. After a while we heard the harsh cry of a bird inside, and could see the white extremity of its beak put out. I offered a rupee to any one who would go up and get out the bird, with the egg or young one, but they all declared it was too difficult, and they were afraid to try. I therefore very reluctantly came away. In about an hour afterwards, much to my surprise, a tremendous loud, hoarse screaming was heard, and the bird was brought me, together with a young one, which had been found in the hole. This was a most curious object, as large as a pigeon, but without a particle of plumage on any part of it. It was exceedingly plump and soft,

* "Malay Archipelago," Vol. I., p. 212.

and with a semi-transparent skin, so that it looked more like a bag of jelly, with head and feet stuck on, than like a real bird."

One genus of these Hornbills is so remarkable as to demand a special notice.

THE GROUND HORNBILLS (*Bucorax*).

These are an African form, of which there are two or three kinds, distinguished by the casque, which is open in the birds from Abyssinia, compressed and shut in the South African species (*B. cafer*).

GROUND HORNBILLS OF ABYSSINIA.

Of the habits of the latter bird several accounts have been written, from which a few extracts are made; and the first is from a letter sent by Mr. Henry Bowker to Mr. Layard, after the publication of the latter's "Birds of South Africa"*:—"There are many superstitions connected with the 'Bromvogel.' The bird is held sacred by the Kaffirs, and is killed only in times of severe drought, when one is killed by order of the 'rain-doctor,' and its body thrown into a pool in a river. The idea is that the bird has so offensive a smell that it will 'make the water sick,' and that the only way of getting rid of this is to wash it away to the sea, which can only be done by heavy rains and flooding of the river. The ground where they feed is considered good for cattle, and in settling in a new country, spots frequented by these birds are chosen by the wealthy people. Should the birds, however, by some chance, fly over a cattle kraal, the kraal is moved to some other place. They are mostly found in

* See Sharpe's Edition of Layard's "Birds of South Africa," p. 122.

groups of from three to six or seven, and build their nests in hollow trees, or in the hollow formed by three or four branches striking off from the same spot. They roost in tall yellow-wood trees, and commence calling about daylight. I never saw one eating carrion, as stated in your book, though I have frequently seen them near the bones of dead cattle, picking up beetles and worms. They will eat meat, mice, and small birds, and swallow them by throwing them suddenly in the air, and letting them drop down the throat in falling. I once had a tame one, and noticed this particularly. It is very weak on the wing, and when required by the 'doctor,' the bird is caught by the men of a number of kraals turning out at the same time, and a particular bird is followed from one hill to another by those on the look-out. After three or four flights it can be run down and caught by a good runner."

Mr. Ayres' account of the species in Natal, though often referred to by other writers, is so excellent that no work treating of South African birds can omit it, and is therefore reproduced here in its entirety:—"In the stomach of the male were snakes, beetles, and other insects. These birds are gregarious, and to be found here all the year round, but are not very plentiful, generally three or four, sometimes more, being found together. They are very fond of hunting for their food on ground from which the grass has been burnt; with their strong bills they peck up the hard ground and turn over lumps in search of insects, making the dust fly again. Having found an insect or other food they take it up, and giving their head a toss, the bill pointing upward, appear to let the food roll down their throat. They also kill large snakes in the following manner, viz.:—On discovering a snake, three or four of the birds advance sideways towards it with their wings stretched out, and with their quills flap at and irritate the snake till he seizes them by the wing-feathers, when they immediately all close round and give him violent pecks with their long and sharp bills, quickly withdrawing again when the snake leaves his hold. This they repeat till the snake is dead. If the reptile advances on them they place both wings in front of them, completely covering the heads and most vulnerable parts. Their call, which consists of but one note repeated—a deep and sonorous *coo-coo*—may be heard at a great distance. I have myself heard it, under favourable circumstances, at a distance of nearly two miles. The call of the female is exactly the same *coo-coo*, only pitched one note higher than the male. The latter invariably calls first, the female immediately answering, and they continue this perhaps for five or ten minutes, every now and then, as they are feeding. Their flight is heavy, and when disturbed, although very shy, they seldom fly more than half a mile before they alight again. At a distance they would easily be mistaken for Turkeys, their body being deep and rather compressed, similarly to those birds, with the wings carried well on the back. The little pouch on the throat they are able to fill with air at pleasure, the male bird sent to me to London doing this before he died. I think their principal range of country is on the coast and from twenty to thirty miles inland. They roost on trees at night, but always feed on the ground."

In Angola, where the bird is called by the natives *Engungoashito*, Mr. Monteiro had great difficulty in procuring specimens, on account of the superstitious dread in which they are held by the natives. He says:—"They are found sparingly nearly everywhere in Angola, becoming abundant, however, only towards the interior. In the mountain range in which Pungo Andongo is situated, and running nearly north and south, they are common, and it was near the base of these mountains that I shot these two specimens. They are seen in flocks of six or eight (the natives say always in equal numbers of males and females). Farther in the interior I was credibly informed that they are found in flocks of from one to two hundred individuals. The males raise up and open and close their tails exactly in the manner of a Turkey, and filling out their bright cockscomb-red, bladder-like wattle on their necks, and with wings dropping on the ground, make quite a grand appearance. They do not present a less extraordinary appearance as they walk slowly with an awkward gait, and peer from side to side with their great eyes in quest of food in the short grass, poking their large bills at any frog, snake, &c., that may come in their way. Their flight is feeble and not long sustained. When alarmed, they generally fly up to the nearest large tree, preferring such as have thick branches with but little foliage, as the *Adansonia*, 'Muenzo' (a wild fig). Here they squat close on the branches, and, if further alarmed, raise themselves quite upright on their legs in an attitude of listening, with wide open bills. The first to notice a person at once utters the customary cry, and all fly off to the next tree. They are very wary, and the grass near the mountains being comparatively

short, with but little scrub or birch, it is very difficult to approach without being observed by them from the high trees. I followed a flock of six for upwards of two hours, crawling flat on my stomach, negro fashion, before I obtained a chance of a shot, when I was so fortunate as to break the wing of a male without otherwise injuring it. It was quickly captured by the blacks. They are omnivorous in their food; reptiles, birds, eggs, beetles, and all other insects, mandioca roots, ginguba or ground-nuts, constitute their food in the wild state. In confinement I have fed this bird upon the same food, also upon fresh fish, which it showed itself very fond of, as well as on entrails of fowls, &c. On letting it loose in Loanda in a yard where there were several fowls with chickens, it immediately gulped down its throat six of the latter, and finished its breakfast with several eggs! The note or cry of the male is like the hoarse blast of a horn, repeated short three times, and answered by the female in a lower note. It is very loud, and can be heard at a considerable distance, particularly at night. They are said to build their nests on the very highest *Adansonias*, in the hollow or cavity formed at the base or junction of the branches with the trunk."

The present species is of a very large size, measuring about forty inches in length, and about nineteen inches in the wing. It is entirely black, with the exception of the primary quills, which are white; the bill and legs are black, but the bare skin on the neck and round the eye is bright red in the male, but blue in the female.

THE FIFTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS. THE HOOPOES (*Upupidæ*).

Different as these birds are in appearance and habits, ornithologists now agree that from their structure they must be placed in close alliance with the Hornbills, with which they are more particularly connected by the Wood Hoopoes. Instead of the ungainly figures and top-heavy-looking casques of the Hornbills, the Hoopoes are remarkable for their graceful carriage and elegant figure, in which the beautiful crest plays an important part. They are particularly at home in the desert countries, where their sandy-coloured plumage is no doubt a great protection to them; and a story is told that the Hoopoe, if it sees a Hawk approaching, will throw itself flat on the ground, and by twisting its wings round in front and remaining motionless, with its bill pointing upwards, it will look like a piece of old rag, and thus escape detection.

Not more than five species of Hoopoe are known, all inhabitants of the Old World, and the most widely distributed is the Common Hoopoe (*Upupa epops*) of Europe, which visits England during the spring and autumn migration, and at least one instance of its breeding in that country is known. Mr. Howard Saunders states * :—"In the year 1847 a pair of Hoopoes nested in a hole of an old yew-tree in a shrubbery of an old-fashioned garden at Leatherhead, Surrey. The proprietor was very anxious that the birds should not be disturbed, and a strict veto was placed upon any bird's-nesting in the shrubbery—a severe trial to our boyish propensities; but we were afterwards rewarded by seeing the parent birds with their young strutting about upon the lawn. As well as I remember, there were five young ones besides the two old birds." The species is found all over central and southern Europe in summer, being in some places very plentiful; but it is a rare visitor to the northern parts, and has disappeared from some countries, like Denmark, for instance, where the felling of the old and hollow forest trees has deprived it of its accustomed breeding-places. In some places the bird is disliked, and in Scandinavia, where it occurs only in the southern and central portions, it bears a bad name among the peasantry, who suppose it to be a foreboder of war and hard times, and from this circumstance its name of Härfugel or "army bird," is derived. The Chinese also have an objection to them, branding them by the name of "Coffin-bird," as they often breed in the holes of exposed Chinese coffins. On the other hand, according to Canon Tristram, in the Sahara the Arabs have a superstitious veneration for the Hoopoe, and its magical properties enter largely into the arcana of the Arab "hakeem." He says that great numbers of Hoopoes resort to the M'zab cities and frequent oases in winter, where they strut about the courtyards and round the tents with the familiarity of barn-door fowls. Mons. Favier says, that in Tangier the superstitious Jews and Mahomedans both believe that the heart and feathers of the Hoopoe are charms against the machinations of evil spirits.

* Sharpe and Dresser, "Birds of Europe," Part VII., 1871.

The ordinary name of Hoopoe is derived from the note of the bird, and in most European languages the latter suggests the vernacular names. Thus, in Bulgaria it is called *Poo-poo*, in Valentia *Put-Put*, *Bubbula*, &c., in Italy, *Poupa* in Portugal, and so on. Mr. Swinhoe writes of the bird and its note as follows :—"I have already described the peculiar way in which the Hoopoe produces its notes—by puffing out the sides of its neck, and hammering on the ground at the production of each

COMMON HOOPOE.

note, thereby exhausting the air at the end of the series of three, which makes up its song. Before it repeats its call, it repeats the puffing of the neck with a slight gurgling noise. When it is able to strike its bill, the sound is the correct *hoo-hoo-hoo ;* but when perched on a rope, and only jerking out the song with nods of the head, the notes more resemble the syllables *hoh-hoh-hoh*. Mr. Darwin makes use of this last fact to show that some birds have instrumental means to produce their music. It is not to this point, however, that I wish to call attention, but to the fact of the bird's puffing out the sides of its neck. It is generally supposed that the song of a bird is produced by actions of the lower larynx on air passing up the bronchial tubes onwards and outwards through the main tube, or trachea. The trachea of the Hoopoe is not dilatable, but its œsophagus is ; and the puffing of the neck is caused by the bulging of the œsophagus with swallowed air. There is no connection between the

œsophagus and the trachea, and apparently no organ at the entrance to the former that could modify sound. What action, then, can this swallowed air be made to take in the production of the bird's notes? Pigeons have strikingly large air-crops, which they empty with each *coo*, and refill before they *coo* again. Many birds swell out the throat when calling or singing, and others move it up and down. These actions must also be caused by the swallowed air in the œsophagus, and must modify the sounds in some way, as variously used, adding power and richness in some cases, or giving ventriloquistic effect in others. This question seems never to have been enquired into before, and I throw out the hint in hopes that others may help to elucidate the matter with their investigations."

The length of the Common Hoopoe is about one foot; the upper surface is greyish-brown, the wings and shoulders black barred with white, the rump being pure white; on the head, which is tawny-coloured, is an enormous crest, the feathers of which have a black tip, before which is a narrow white bar; the tail is black, with a white band at about a third of its length from the end: underneath the body is pale cinnamon, white on the abdomen and under tail coverts, the flanks striped with brown. The sexes are alike in colour, excepting that the female is a little paler.

THE WOOD HOOPOES (*Irrisor*).

All the birds belonging to this section of the Hoopoes are remarkable for their very long and strongly graduated tails, for their brilliant metallic plumage, which is always dark, and inclining more or less to black—instead of a sandy colour, as in the true Hoopoes—and most of them for their very curved, scimitar-like bills. They are all natives of Africa, and have a remarkably loud, chattering note; and from its harsh and resounding voice the Red-billed Wood Hoopoe (*I. erythrorhynchus*) is known among the Dutch at the Cape as "Cackala," or the "Chatterer." The late M. Jules Verreaux told the writer that the noise made by these birds is tremendous, and that on one occasion he was attracted by an uproar, which seemed to indicate that something unusual was the matter. On proceeding to the place whence the noise came, he was astonished to find on the low branch of a tree three of these birds, perched one on the back of the other, betokening by their drooping wings and repeated chatterings the utmost consternation and fright. The cause of this was not far to seek, for just below the birds was a cobra, balancing himself in an erect attitude, and perfectly motionless, the only indication of life being the incessant flicking of the animal's tongue. The cacklings of the birds became feebler and feebler, until at last the bottom one fell off the perch and dropped into the extended jaws of the snake, which were ready to receive it; while the other two birds, apparently freed from the spell of the reptile's eye, took to instant flight. Having his gun in his hand, M. Verreaux shot the snake immediately; but on going to rescue the bird, found that the latter was quite dead. Mr. Thomas Ayres, who has studied the species in Natal, says:—"The food of these birds consists almost entirely of a species of cockroach, which they take from the crevices of rough-barked trees, and in search of which they creep about the trunk and branches somewhat similarly to the Woodpeckers. In this manner their tail-feathers frequently become much worn. From four to eight of these birds are generally together, and frequent bushy country. They have a loud chattering note, and are extremely restless in their habits. They have a peculiarly powerful and disagreeable smell." Mr. Andersson's account of the species is as follows:—"It lives in small flocks—probably consisting of entire families—which frequent trees, chiefly of the larger kinds, and examine them most assiduously in search of insects and their larvæ, which they extract from crevices in the wood and from beneath the bark. These birds climb like Woodpeckers; and their long tails come into constant contact with the rough surface of the trees, by which the tail-feathers are much injured. When they have finished their examination of one tree they move to the next convenient one, but not all together, as a short interval generally elapses after the departure of each individual. The moment flight is decided on, they utter harsh discordant cries or chatterings, which are continued until they are all safely lodged in their new quarters. These harsh notes are also heard when they conceive themselves in danger from either man, beast, or bird; and they thus often betray their presence."

The present species measures about seventeen inches, the tail being about ten out of that number, and being thus three inches longer than the body of the bird. The colour is black, glossed with green on the head, back, and under surface, with blue on the throat, purple on the wings and tail.

and having a bronzy gloss on the shoulders. All the tail feathers, except the two centre ones, have a white spot near the tip and across the wings a white bar. The bill and legs are bright coral red.

CHAPTER X.

THE BEE-EATERS—MOTMOTS—ROLLERS—TROGONS—NIGHTJARS, OR GOATSUCKERS—SWIFTS—HUMMING BIRDS.

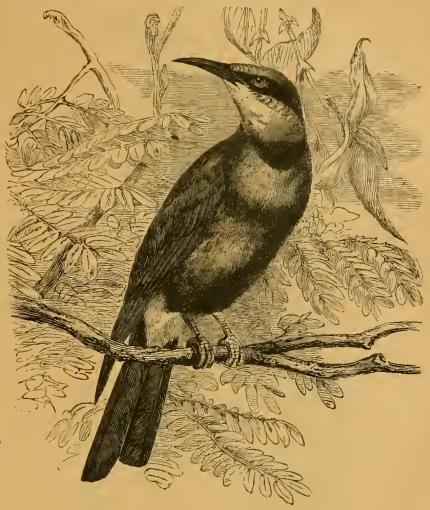
THE BEE-EATERS—Their Brilliant Plumage—Colonel Irby's Account of the Bird in Spain—Shot for Fashion's sake—THE MOTMOTS—Appearance—Mr. Waterton on the Houtou—Curious Habit of Trimming its Tail—Mr. O. Salvin's Observations on this point—Mr. Bartlett's Evidence—THE ROLLERS—Why so called—Canon Tristram's Account of their Habits—Colour—Other Species—THE TROGONS—Where found—Peculiar Foot—Tender Skin—Inability to Climb—Their Food—THE LONG-TAILED TROGON, OR QUESAL—Mr. Salvin's Account of its Habits—Its Magnificent Colour—How they are Hunted—THE NIGHTJARS, OR GOATSUCKERS—Appearance—Distribution—The Guacharo, or Oil-bird—"Frog-mouths"—Mr. Gould's Account of the Habits of the Tawny-shouldered Podargus—How it Builds its Nest—Mr. Waterton's Vindication of the Goatsucker—What Services the Bird does really render Cattle, Goats, and Sheep—Its Cry—The Common Goatsucker—THE SWIFTS—THE COMMON SWIFT—Migration—Their Home in the Air—Where they Breed—Nest—Tree-Swifts—The Edible-Nest Swiftlets—Mr. E. L. Layard's Visit to the Cave of the Indian Swiftlet—THE HUMMING BIRDS—Number of Species—Distribution—Professor Newton's Description of the Bird—Mr. Wallace on their Habits—Wilson on the North American Species.

THE SIXTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS. THE BEE-EATERS (*Meropidæ*).

THE Bee-eaters are among the most brightly plumaged of the Picarian birds, and are distributed over the whole of Africa, India, the Moluccas, and Australia. One species (*Merops apiaster*) visits Europe in the summer, being, however, nowhere so common as in the countries of the Mediterranean basin, though they occasionally wander to England. Colonel Irby* gives the following account of the Bee-eater in Southern Spain:—"The bird did not appear to me to be quite so common in Morocco at the end of April as on the Spanish side of the Strait, where, during April, May, June, and July, it is one of the most conspicuous birds in the country; at that season, Andalusia without Bee-eaters would be like London without Sparrows. Everywhere they are to be seen; and their single note, *teerp*, heard continually repeated, magnifies their numbers in imagination. Occasionally, they venture into the centre of towns when on passage, hovering round the orange-trees and flowers in some patio or garden. Crossing the Strait for the most part in the early part of the day, flight follows flight for hours in succession. When passing at Gibraltar, they sometimes skim low down to settle for a moment on a bush or a tree, but generally go straight on, often almost out of sight; but their cry always betrays their presence in the air. In some places they nest in large colonies; in others there are, perhaps, only two or three holes. When there are no river-banks or barrancos in which to bore holes, they tunnel down into the ground, where the soil is suitable, in a vertical direction, generally on some slight elevated mound. The shafts to these nests are not usually so long as those in banks of rivers, which sometimes reach to a distance of eight or nine feet in all; the end is enlarged into a round sort of chamber, on the bare soil of which the usual four or five shining white eggs are placed. After a little they become discoloured from the castings of the old birds, the nest being, as it were, lined with the wings and undigested parts of Bees and Wasps. Vast numbers of eggs and young must be annually destroyed by Snakes and Lizards. The latter are often seen sunning themselves at the entrance of a hole among a colony of Bee-eaters; and frequently have I avenged the birds by treating the yellow reptile to a charge of shot. The bills of Bee-eaters, after boring out their habitations, are sometimes worn away to less than half their usual length; but as newly-arrived birds never have these stumpy bills, it is evident that they grow again to their ordinary length. It has often been a source of wonder to me how they have the exertion to make these long tunnels: the amount of exertion must be enormous: but when one considers the holes of the Sand-Martin, it is perhaps not so surprising after all. During my stay at Gibraltar, Bee-eaters decreased very much in the neighbourhood, being continually shot on account of their bright plumage, to put in ladies' hats. Owing to this sad fashion,

* "Ornithology of the Strait of Gibraltar," p. 66.

I saw no less than seven hundred skins, all shot at Tangier in the spring of 1874, which were consigned by Olcese to some dealer in London. However, the enormous injury these birds do to the peasants who keep Bees fully merits any amount of punishment, but, at the same time, they destroy quantities of Wasps. After being fired at once or twice, they become very wary and shy at the breeding-places; and the best way to shoot them is to hide near the *colmenares*, or groups of *corchos*, or cork bee-hives, which in Spain are placed in rows, sometimes to the number of seventy or eighty together; and it is no unusual thing to see as many Bee-eaters whirling round and swooping down, even seizing the bees at the very entrance of their hives. The reason of their early departure in August is to be accounted for by the simple fact that bees cease to work when there are no flowers, and by that time all vegetation is scorched up." The Bee-eater suffers probably less from the fashionable rage after its plumes than do some of the bright-coloured birds, as it goes in winter to South Africa, where it rears another brood of young ones.



AUSTRALIAN BEE-EATER.

THE SEVENTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS. THE MOTMOTS (*Momotidæ*).

These birds are peculiar to the New World, being found from Mexico southwards through the whole of Central America and the South American continent. Their general plumage is green, and the majority of the species have a large racket at the end of the centre tail-feathers, formed by the bird itself, as detailed below. Mr. Waterton gives an account of the Motmots in Demerara, and he was the first to point out that the racket in the tail was produced by the bird's own action. He writes:—"The Houtou ranks high in beauty amongst the birds of Demerara. His body is green, with a bluish cast in the wings and tail; his crown, which he erects at pleasure, consists of black in the centre, surrounded with lovely blue of two different shades; he has a triangular black spot, edged with blue, behind the eye, extending to the ear; and on his breast a sable tuft, consisting of nine feathers, edged also with blue. This bird seems to suppose that its beauty can be increased by trimming the tail, which undergoes the same operation as one's hair in a barber's shop, only with this difference, that it uses its own beak, which is serrated, in lieu of a pair of scissors. As soon as his tail is full-grown, he begins about an inch from the extremity of the two longest feathers in it, and cuts away the web on both sides of the shaft, making a gap about an inch long. Both male and female adonise their tails in this manner, which gives them a remarkable appearance amongst all other birds. While we consider the tail of the Houtou blemished and defective, were he to come amongst us, he would probably consider our heads, cropped and bald, in no better light. He who wishes to observe this handsome bird

BILL OF MOTMOT.

in his native haunts must be in the forest at the morning's dawn. The Houtou shuns the society of man; the plantations and cultivated parts are too much disturbed to engage it to settle there. The thick and gloomy forests are the places preferred by the solitary Houtou. In those far-extending wilds, about day-break, you hear him articulate, in a distinct and mournful tone, 'Houtou, houtou.' Move cautiously on to where the sound proceeds from, and you will see him sitting in the underwood, about a couple of yards from the ground, his tail moving up and down every time he articulates 'houtou.' He lives on insects and the berries among the underwood; and very rarely is seen in the lofty trees, except the bastard Siloabali-tree, the fruit of which is grateful to him. He makes no nest, but rears his young in a hole in the sand, generally on the side of a hill."

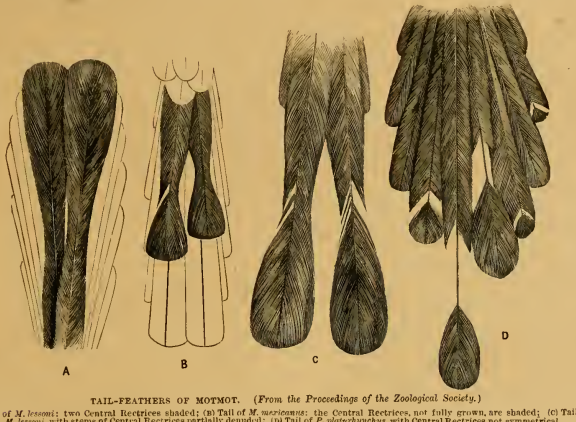
MOTMOT.

In confirmation of Mr. Waterton's remarks, a paper was published by Mr. Osbert Salvin in the "Proceedings of the Zoological Society" for 1873 (p. 429):—"Some years ago (1860) this Society possessed a specimen of *Momotus subrufescens*, which lived in one of the large cages of the parrot-house all by itself. I have a very distinct recollection of the bird; for I used every time I saw it to cheer it up a bit by whistling such of its notes as I had picked up in the forests of America. The bird always seemed to appreciate this attention; for though it never replied, it became at once animated, hopped about the cage, and swung its tail from side to side like the pendulum of a clock. For a long time its tail had perfect spatules; but towards the end of its life I noticed that the median feathers were no longer trimmed with such precision; and on looking at its beak I noticed that from some cause or other it did not *close properly*, but gaped slightly at the tip, and had thus become unfitted for removing the vanes of the feathers. Since the subject has been revived by Dr. Murie, it occurred to me that Mr. Bartlett could hardly have failed to watch this bird during its moults, and whilst the tail-feathers were growing. I accordingly wrote to him, and received the following reply:—

'DEAR SIR,—During the several years the Motmot lived here I had many opportunities of watching its habits; and *I have seen the bird in the act of picking off the webs of the central feathers of its tail*, and have taken from the bottom of the cage the fragments of web that fell from the bird's bill. As the bird

lived here for some years, its bill got rather out of order, that is, it did not close properly at the point; and consequently the picking off the web at last was imperfectly performed, and the two sides of the tail-feather presented an unequal and unfinished appearance. I noticed also that the Motmot frequently threw up castings, after the manner of the Kingfishers and other birds that swallow indigestible substances.—Yours faithfully, A. D. BARTLETT.'

"The point is further elucidated by the examination of skins in our collection. We have a number of specimens of various species in which the central tail-feathers were growing when the birds were shot. The drawings now exhibited show some of them. Figure A represents the tail of a young *Momotus lessoni* in its first plumage. The central tail-feathers are here untouched; they merely show the reduction in the breadth of the web in the part which is subsequently denuded. Of this more anon. Figure B shows the growing feathers of the tail of a specimen of *Momotus mexicanus*; in this a few vanes have been removed from the left-hand feather. Figure C shows the process of denudation



TAIL-FEATHERS OF MOTMOT. (*From the Proceedings of the Zoological Society.*)
(A) Tail of *M. lessoni*: two Central Rectrices shaded; (B) Tail of *M. mexicanus*: the Central Rectrices, not fully grown, are shaded; (C) Tail of *M. lessoni*, with stems of Central Rectrices partially denuded; (D) Tail of *P. platyrhynchus*, with Central Rectrices not symmetrical.

still further advanced. In all these three birds it will be noticed that the feathers in question have grown symmetrically, both being of nearly equal length. Figure D represents the tail of a *Prionirhynchus platyrhynchus*, where these feathers have not grown symmetrically, but the left-hand one has been developed sooner than the right-hand one. What has happened? The bird expecting to find *two* feathers upon which to operate has commenced to nibble not only the left central rectrix, but also the next rectrix on the right-hand side! But it seems to have not felt very certain about the state of its tail, for it has wandered off to one of the others, and commenced nibbling it also. When, however, the proper right-hand feather appeared, these mistakes have been discovered, and the work recommenced in the usual way. I can interpret in no other way the state in which the feathers on the right-hand side of the tail of this bird appear."

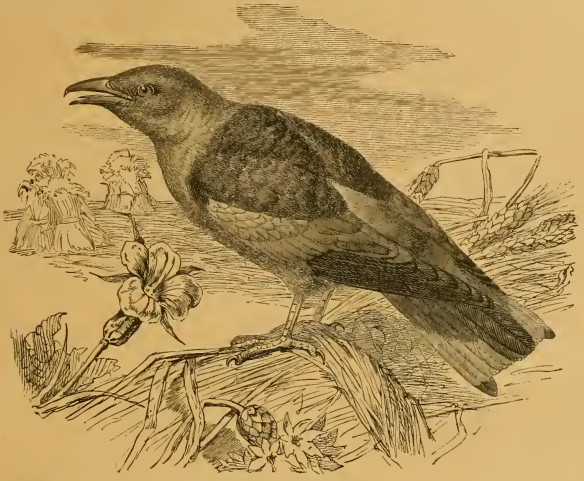
THE EIGHTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS. THE ROLLERS (*Coraciadæ*).

These birds constitute a family of birds which are strictly denizens of the Old World, and are remarkable for their bright plumage. The vernacular name of Roller is given to them from their habit of mounting or "rolling" in the air. Canon Tristram, in describing the habits of the European species (*Coracias garrula*) in Palestine, writes as follows:—"On the 12th of April I reached Ain Sultan

(Jericho) alone, and remained there in solitude for several days, during which I had many opportunities of observing the grotesque habits of the Roller. For several successive evenings, great flocks of Rollers mustered shortly before sunset on some *dôm* trees near the fountain, with all the noise but without the decorum of the Rooks. After a volley of discordant screams, from the sound of which it derives its Arabic trivial name of 'Schurkrak,' a few birds would start from their perch, and commence a series of somersaults overhead, somewhat after the fashion of Tumbler Pigeons. In a moment or two they would be followed by the whole flock, and these gambols would be repeated for a dozen times or more. Everywhere it takes its perch on some conspicuous branch or on the top of a rock, where it can see and be seen. The bare tops of the fig-trees, before they put forth their leaves, are, in the cultivated terraces, a particularly favourite resort. In the barren Ghor I have often watched it perched unconcernedly on a knot of gravel or marl in the plain, watching apparently for the emergence of beetles from the sand. Elsewhere I have not seen it settle on the ground. Like Europeans in the East, it can make itself happy without chairs and tables in the desert, but prefers a comfortable easy-chair when it is to be found. Its nest I have seen in ruins, in holes in rocks, in burrows, in steep sand-cliffs, but far more generally in hollow trees. The colony in the Wady Kelt used burrows excavated by themselves; and many a hole did they relinquish, owing to the difficulty of working it. But so cunningly were the nests placed under a crumbling treacherous ledge, overhanging a chasm of perhaps one or two hundred feet, that we were completely foiled in our siege. We obtained a nest of six eggs, quite fresh, in a hollow tree in Bashan, near Gadara, on the 6th of May. It is noticed by Russell among the birds of Aleppo." The colour of the Common Roller is very beautiful, and we can well understand the significance of the Turkish name "Alla Carga," or Beautiful Crow. The back is pale cinnamon-brown; the wing-coverts pale blue, excepting those on the edge of the wing, which are rich ultramarine; the quills brownish-black, deep ultramarine underneath; the secondaries with more blue on the outer web; the forehead white; the crown of the head and back of the neck pale blue; the lower back and rump ultramarine; the upper tail-coverts greenish-blue; the tail blackish-brown, the feathers blue at the base, the two centre feathers dull green; cheeks and throat pale blue, streaked with silvery blue; the under surface of the body pale greenish-blue. The total length is twelve inches. One curious feature about the European bird is that the outer tail-feather tends towards a point at the tip, as if there was an inclination to become elongated; and in Africa there is a species which actually differs from the European Roller only in having the outer tail-feathers elongated to an extent of several inches.

In Madagascar, that wonderful island which produces so many peculiar forms of bird life, there are found the Ground Rollers (*Atelornis*), extraordinary birds which live entirely on the ground, and only come out at dusk. Their flight is said by M. Grandidier to be very weak, so that the birds are never found above the lowest branches. They are rather local in their habitat, but where they do occur seem not to be uncommon. The Cyrombo Roller (*Leptosoma discolor*) is also a native of Madagascar, and has at first sight much the appearance of a Cuckoo, of which family of birds it was for many years considered to be a member. The head is extremely large in this bird, and the region of the nostrils densely plumed; but the latter, instead of being placed near the base of the bill, as in most Rollers, are situated nearly in the middle of the upper mandible. Messrs. Pollen and Van Dam give an interesting account of this bird in their notes on the "Birds of Madagascar":—"The natives of the north-west of Madagascar give this bird the name of Cyrombo. It has the curious habit of hovering in the air, and uttering a very loud note, striking its wings against its body as it calls. This cry, resembling the syllables *tu-hou, tu-hou, tu-hou*, goes on increasing in force. Nowhere have we found this bird in greater numbers than in the forests in the neighbourhood of the bays of Boény and Jongony, in the south-western portion of the island of Mayotte. The racket that they make during the whole journey is truly wearisome. Although very active as criers, these birds are lazy and stupid. As soon as they are perched on the branch of a tree, they remain, so to speak, immovable, and in perpendicular position, so that it is easy to see them and knock them over. When seen in this position, they look like birds impaled. We suppose that they live in polyandry, because one always sees three times as many males as females; often we have seen three males in company with one single female, and all allowed themselves to be killed one after the other. In fact, when one is killed, the others do not fly away, but content themselves with merely moving from one branch to

another. These birds live principally on Grasshoppers, but they devour also Chameleons and Lizards, which gives to their flesh a disagreeable odour, like that we observe in the Common Cuckoo. In preparing these birds we often found them with a species of large parasite of the family of the Ornithomyiæ, of a dirty green colour. We were never able to study the propagation of this bird; but while in Mayotte we saw an individual make a nest of rushes in the hole of a great 'Badamier' (*Terminalia Catappa*). These birds when they cry puff out the throat, so that this portion of the body has the appearance of a pendent bag. When wounded, they erect the feathers of the forehead and ears as well as those of the throat, all the while distributing well-aimed blows with the beak. The Cyrombo plays a great part in the chants and religious recitations of the Malagasy natives. The



BLUE ROLLER.

French colonists of Mayotte call this bird the 'Parrot.' It is common at Madagascar and Mayotte, and has, according to Mr. Sclater, been found in the island of Anjounan."

THE NINTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.—THE TROGONS (*Trogonidæ*).

These beautiful birds are found both in the Old World and the New, but are inhabitants of the tropical latitudes only. In Africa two species only are known, nor does another species occur until the coast of India is reached, and then in the forests of the peninsula and of the Himalayas there are some beautiful red-breasted representatives of the family, whence throughout the Malayan peninsula and the Sunda Islands some of the handsomest Trogons occur. But it is in America, from Mexico southwards, that the larger number of species is met with, no less than thirty-three out of a total of forty-six Trogons being peculiar to the New World. Their habits vary somewhat, as all the Old World members are insectivorous, while the American species principally feed on fruit, and only devour insects in a secondary manner. The Trogons may be distinguished not only by their broadened bill, but by the foot, where the first and second toes are turned permanently, two in front and two behind. This is a different arrangement to that of the Cuckoos and other

climbing *Picariæ*, where the fourth toe is permanently or temporarily turned backwards as well as the first. The skin of these birds is remarkably thin and tender, so that their preparation is by no means an easy matter, and their appearance is also detracted from by a scantiness of plumage on the nape, where a great want of feathers takes place. Mr. Wallace, writing of the birds of this present family, remarks:—"As an instance how totally unable the Trogons are to use their feet for anything like climbing, we may mention that the Trogons of South America feed principally on fruit, which one would think they would get by climbing or walking after, if they could. But no; they take their station on a bare branch about the middle of the tree, and having fixed their attention on some particularly tempting fruit, they dart at it, seize it dexterously on the wing, and return to their original seat. Often, while waiting under a fruit-tree for Chatterers or Pigeons, have we received the first intimation of the presence of a Trogon by the *whir-r-r* of its wings as it darted after a fruit. It is curious that this habit seems confined to the Trogons of America. In the East I have never yet observed it, and in the numerous specimens I have opened, nothing has been found but insects. The African Trogons also appear to be wholly insectivorous."

Again, in his "Naturalist in Nicaragua" (p. 122) Mr. Belt writes:—"The Trogons are general feeders. I have taken from their crops the remains of fruits, grasshoppers, beetles, termites, and even small crabs and land shells. The largest species, the Massena Trogon (*Trogon massena*), is one foot in length, dark bronze-green above, with the smaller wing-feathers speckled white and black, and the belly of a beautiful carmine. Sometimes it sits on a branch above where the army of ants are foraging below, and when a grasshopper or other large insect flies up and alights on a leaf it darts after it, picks it up, and returns to its perch. I sometimes found them breaking into the nests of the termites with their strong bills, and eating the large soft-bodied workers, and it was from the crop of this species that I took the remains of a small crab and land shell (*Helicina*). They take short, quick, jerking flights, and are often met with along with flocks of other birds—Fly-catchers, Tanagers, Creepers, Woodpeckers, &c., that hunt together, traversing the forests in flocks of hundreds, belonging to more than a score of different species, so that while they are passing over the trees seem alive with them. Mr. Bates has mentioned similar gregarious flocks met with by him in Brazil; and I never went any distance into the woods around St. Domingo without seeing them. The reason of their association together may be partly for protection, as no rapacious bird or mammal could approach the flock without being discovered by one or other of them; but the principal reason appears to be that they play into each other's hands in their search for food. Creepers and Woodpeckers and others drive the insects out of their hiding-places under bark, amongst moss and withered leaves. The Flycatchers sit on branches and fly after the larger insects, the Flycatchers taking them on the wing, the Trogons from the leaves on which they have settled."

THE LONG-TAILED TROGON, OR QUESAL (*Pharomacrus* mocinno*).

This beautiful species is mentioned in Willughby's Ornithology, which was published some two hundred years ago, in which book an appendix is devoted to such birds as the author suspected to be "fabulous;" and the Quetzaltototl of Hernandez was placed in this category, nor was it till the French traveller Delattre visited Guatemala, and published his account of the habits of the bird in 1843, that it was restored to its proper position as one of the most beautiful of the feathered tribe: it is now by no means rare in collections. The best account of the habits of this species—and, indeed, of any Trogon—is that given by Mr. Osbert Salvin, in his paper entitled "Quesal-shooting in Vera Paz,"† in Guatemala. He writes from his diary:—"Off to the mountains at last, with a fine day and a fair prospect of success. The road, after crossing the river, strikes off to the northward—a mountain track winding among the hills. Soon after entering the forest, a river crosses the path—a foaming torrent—a fall into which gives no hope of escape. A felled tree, one of the largest of the forest, forms the bridge, over which, slippery with moss and foam, we have to pass. For ourselves it is nothing; but I must say I tremble for the Indians, each of whom carries his 75lbs. of cargo. In the worst and most slippery part, the foothold is somewhat improved by the tree being notched with a 'machete;' but still it is as dangerous a pass as I ever crossed. After half-an-hour's delay, we reach the other bank. One 'mozo' only turned faint-hearted, and another carried his pack across. From

* φάρος, a mantle; μακρός, large. † Ibis, 1861, p. 138.

LONG-TAILED TROGON, OR QUESAL.

the river the path becomes very precipitous, and we continue to climb till we reach the foot of a rock, where we find a deserted rancho, and take possession. A fire having been made to heat the pixtones, we dine, and afterwards start for the forest close by to look for Quesals. On entering, the path takes the unpleasant form of a succession of felled trees, which are slippery from recent rains, and render progress slow. My companions are ahead, and I am just balancing myself along the last trunk, when Filipe comes back to say that they have heard a Quesal. Of course, being especially anxious to watch as well as to shoot one of these birds myself, I immediately hurry to the spot. I sit down upon my wide-awake in most approved style close to Cipriano, who is calling the bird, and wait, all eyes and ears, for the result. I have not to wait long. A distant clattering note indicates that the bird is on the wing. He settles—a splendid male—on a bough of a tree, not seventy yards from where we are hidden. Cipriano wants to creep up to within shot, but I keep him back, wishing to risk the chance of losing a specimen rather than miss such an opportunity of seeing the bird in its living state, and of watching its movements. It sits almost motionless on its perch, the body remaining in the same position, the head only moving slowly from side to side. The tail does not hang quite perpendicularly, the angle between the true tail and the vertical being perhaps as much as fifteen or twenty degrees. The tail is occasionally jerked open and closed again, and now and then slightly raised, causing the long tail-coverts to vibrate gracefully. I have not seen all. A ripe fruit catches the Quesal's eye, and he darts from his perch, hovers for a moment, plucks the berry, and returns to his former position. This is done with a degree of elegance that defies description. The remark has often been made by persons looking at stuffed Humming-birds, 'What lovely little things these must look in life, when they are flying about!' But they do not. Place a Humming-bird twenty yards from you, and what do you see of its colours, except in the most favourable position and light? This is not the case with the Quesal. The rich metallic green of the head, back, and tail-coverts reflects its colour in every position, whilst the deep scarlet of the breast and the white of the tail show vividly at a distance, and contrast with the principal colour of the body. The living Quesal strikes the eye by its colour at once. It stands unequalled for splendour among birds of the New World, and is hardly surpassed among those of the Old. Such are my reflections, when a low whistle from Cipriano calls the bird nearer, and a moment afterwards it is in my hand—the first Quesal I have seen and shot.

"The cries of the Quesal are various. They consist principally of a low double note, '*whe-oo, whe-oo,*' which the bird repeats, whistling it softly at first, and then gradually swelling it into a loud but not unmelodious cry. This is often succeeded by a long note, which begins low, and after swelling, dies away as it began. Both these notes can be easily imitated by the human voice. The bird's other cries are harsh and discordant. They are best imitated by doubling a pliant leaf over the first fingers, which must be held about two inches apart. The two edges of the leaf being then placed in the mouth, and the breath drawn in, the required sound is produced. Cipriano was an adept at imitating these cries, but I failed in producing them for want of practice. When searching for Quesals, the hunter whistles as he walks along, here and there sitting down and repeating the other notes. As soon as he hears a bird answering at a distance he stops, and imitates the bird's cries until it has approached near enough to enable him either to shoot it from where he stands, or to creep up to within shot. The female generally flies up first, and perches on a tree near the hunter, who takes no notice of her, but continues calling till the male, who usually quickly follows the female, appears. Should the male not show himself, the hunter will sometimes shoot the female. Thus it is that so large a proportion of males are shot. The flight of the Quesal is rapid and straight; the long tail-feathers, which never seem to be in his way, stream after him. The bird is never found except in forests composed of the highest trees, the lower branches of which (*i.e.*, those at about two-thirds of the height of the tree from the ground) seem to be its favourite resort. Its food consists principally of fruit, but occasionally a caterpillar may be found in its stomach."

The distinguishing character of this fine Trogon is the long tail of the male bird, which measures about three feet in length. The colour of the upper parts is golden green, as well as the throat and fore neck; the breast is bright scarlet, and is overshadowed by some beautiful drooping plumes, which spring from the shoulders, and hang gracefully over the wings; the outer tail-feathers are white, with black bases, and the bill is yellow. The female has a black bill, and is much smaller, and she does not possess the long tail and decorative plumes of the male.

THE TENTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.—THE NIGHTJARS, OR GOATSUCKERS (*Caprimulgidæ*).

From the adjoining woodcut it will be seen that a Nightjar is indeed a Fissirostral, or wide-gaping bird, and this large mouth is characteristic of the whole family. Their soft mottled plumage, their large eyes, and their habit of flying by night, have induced many naturalists to place them in close proximity to the Owls, with which family of birds, however, they have nothing further in common. Members of the family of Goatsuckers are distributed nearly all over the world, with the exception of the islands of Oceania, and a great difference is observable in their size and form, and to some extent in their habits. Thus the Guacharo, or Oil-bird (*Steatornis* caripensis*), is met with only in the island of Trinidad, where it is also called *Diablotin*, and where it inhabits the inmost recesses of caverns, either by the sea or inland. The birds spend the entire day in these dark recesses, and come out only at night to procure their food, which consists of the fruits of different palms, the seeds of which are rejected, and form, with the droppings of the birds, a thick flooring of guano in some of the caves. Sometimes the bird forms a huge cradle of this deposit, apparently for the greater security of its young ones; and one of these singular nests, if such they may

MOUTH OF GOATSUCKER.

OIL-BIRD.

be called, is exhibited in the British Museum. The nestlings become very fat, and are sometimes eaten, but according to M. Léotand, in his work on the Birds of Trinidad, there is a certain odour about them which makes them unpalatable to the appetite of most people.

In India and in the Malayan Archipelago is found a group of Nightjars belonging to the genus

* στέαρ, στεατος, fat; ὄρνις, a bird.

*Batrachostomus** popularly known as "Frog-mouths;" their place is taken in Australia and New Guinea by the giants of the family—the *Podargi*, examples of which are generally to be seen in the London Zoological Gardens. Of the Tawny-shouldered *Podargus* (*P. strigoides*†) Mr. Gould gives the following account:—"Like the rest of this genus, this species is strictly nocturnal, sleeping throughout the day on the dead branch of a tree, in an upright position across, and never parallel to, the branch, which it so nearly resembles as scarcely to be distinguished from it. I have occasionally seen it beneath the thick foliage of the *Casuarinæ*, and I have been informed that it sometimes shelters itself in the hollow trunks of the *Eucalypti*, but I could never detect one in such a situation; I mostly found them in pairs, perched near each other on the branches of the gums, in situations not at all sheltered from the beams of the midday sun. So lethargic are its slumbers, that it is almost impossible to arouse it, and I have frequently shot one without disturbing its mate, sitting close by; it may also be knocked off with sticks or stones, and sometimes it is even taken with the hand. When aroused, it flies lazily

COMMON GOATSUCKER.

off, with heavy flapping wings, to a neighbouring tree, and again resumes its slumbers until the approach of evening, when it becomes as animated and active as it had been previously dull and stupid. The stomach of one I dissected induced me to believe that it does not usually capture its prey while on the wing, or subsist on nocturnal insects alone, but that it is in the habit of creeping among the branches in search of such as are in a state of repose. The power it possesses of shifting the position of the outer toe backwards, as circumstances may require, is a very singular feature, and may also tend to assist them in their progress among the branches. A bird I shot at Yarrundi, in the middle of the night, had the stomach filled with fresh-captured Mantis and Locusts (*Phasmidæ* and *Cicadæ*), which seldom move at night, and the latter of which are generally resting against the upright boles of the trees. In other specimens I found the remains of small Coleoptera, intermingled with the fibres of the roots of what appeared to be a parasitic plant, such as would be found in decayed and hollow trees. The whole contour of the bird shows that it is not formed for extensive flight or for performing those rapid evolutions that are necessary for the capture of its prey in the air: the wing being short and concave in comparison with those of the true aërial Nightjars, and particularly with the Australian form, to which I have given the name of *Eurostopodus*.

* βάτραχος, a frog; στόμα, a mouth † Owl-like.

"Of its mode of nidification I can speak with confidence, having seen many pairs breeding during my rambles in the woods. It makes a slightly-constructed flat nest of sticks, carelessly interwoven together, and placed at the fork of a horizontal branch of sufficient size to ensure its safety; the trees most frequently chosen are the *Eucalypti*, but I have occasionally seen the nest on an apple-tree (*Angophora*) or a swamp-oak (*Casuarina*). In every instance one of the birds was sitting on the eggs, and the other perched on a neighbouring bough, both invariably asleep. That the male participates in the duty of incubation I ascertained by having shot a bird on the nest, which, on dissection, proved to be a male. The eggs are generally two in number, of a beautiful immaculate

WHIP-POOR-WILL.

white, and of a long oval form, one inch and ten lines in length by one inch and three lines in diameter.

"Like the other species of the genus, it is subject to considerable variation in its colouring, the young, which assume the adult livery at an early age, being somewhat darker in all their markings. In some a rich tawny colour predominates, while others are more grey. The night call of this species is a hoarse noise, consisting of two distinct sounds, which cannot correctly be described. The stomach is thick and muscular, and is lined with a hair-like substance, like that of the common Cuckoo."

Mr. Waterton gives the following notes on Goatsuckers in his "Wanderings" (p. 139):—"When the sun has sunk in the western woods, no longer agitated by the breeze, when you can only see a straggler or two of the feathered tribe hastening to join its mate, already at its roosting-place, then it is that the Goatsucker comes out of the forest, where it has sat all day long in slumbering ease, unmindful of the gay and busy scenes around it. Its eyes are too delicately formed to bear the light, and thus it is forced to shun the flaming face of day, and wait in patience till night invites him to partake of the pleasures her dusky presence brings. The harmless, unoffending Goatsucker, from the time of Aristotle down to the present day, has been in disgrace with man. Father has handed it down to son, and author to author, that this nocturnal thief subsists by

milking the flocks. Poor injured little bird of night, how sadly hast thou suffered, and how foul a stain has inattention to facts put upon thy character! Thou hast never robbed man of any part of his property, nor deprived the kid of a drop of milk.

"When the moon shines bright you may have a fair opportunity of examining the Goatsucker. You will see it close by the Cows, Goats, and Sheep, jumping up every now and then under their bellies. Approach a little nearer—he is not shy: 'he fears no danger, for he knows no sin.' See how the nocturnal flies are tormenting the herd, and with what dexterity he springs up and catches them as fast as they alight on the bellies, legs, and udders of the animals. Observe how quiet they stand, and how sensible they seem of his good offices, for they neither strike at him nor hit him with their tails, nor tread on him, nor try to drive him away as an uncivil intruder. Were you to dissect him and inspect his stomach, you would find no milk there. It is full of the flies which have been annoying the herd.

"The pretty mottled plumage of the Goatsucker, like that of the Owl, wants the lustre which is observed in the feathers of the birds of day. This at once marks him as a lover of the pale moon's nightly beams. There are nine species here (Demerara); the largest appears nearly the size of the English Wood Owl. Its cry is so remarkable that, having once heard it, you will never forget it. When night reigns over these immeasurable wilds, whilst lying in your hammock, you will hear this Goatsucker lamenting like one in deep distress. A stranger would never conceive it to be the cry of a bird; he would say it was the departing voice of a midnight murdered victim, or the last wailing of Niobe for her poor children before she was turned into stone. Suppose yourself in hopeless sorrow, begin with a high loud note, and pronounce 'Ha, ha, ha, ha, ha, ha, ha!' each note lower and lower, till the last is scarcely heard, pausing a moment or two betwixt every note,

LYRE-TAILED NIGHTJAR.

and you will have some idea of the moaning of the largest Goatsucker in Demerara. Four other species of the Goatsucker articulate some words so distinctly that they have received their names from the sentences they utter, and absolutely bewilder the stranger on his arrival in these parts. The most common one sits down close by your door, and flies, and alights three or four yards before you as you walk along the road, crying 'Who are you, who-who-who-are-you.' Another bids you 'Work away, work-work-work-away.' A third cries mournfully, 'Willy-come-go, willy-willy-willy-come-go.' And high up in the country a fourth tells you to 'Whip-poor-will, whip-whip-whip-poor-will.' You will never persuade the negro to destroy these birds, or get the Indian to let fly his arrows at them. They are birds of omen and reverential dread. Jumbo, the demon of Africa, has them under his command, and they equally obey the Yabahou, or Demeraran Indian Devil. They are receptacles for departed souls who come back again to earth, unable to rest for crimes done in their days of nature; or they are expressly sent by Jumbo or Yabahou to haunt cruel or hard-hearted monsters, and retaliate injuries received from them. If the largest Goatsucker chance to cry near the white man's door, sorrow and grief will soon be inside; and they expect to see the master waste away with a slow consuming sickness. If it be heard close to the negro's or Indian's hut, from that night misfortune sits brooding over it, and they await the event in terrible suspense."

The common Goatsucker, which is also popularly known as the "Fern Owl," or "Nightjar," visits England only in the spring, when it arrives from Southern Africa, and distributes itself over the country. It is by no means an uncommon bird, but is rarely seen, owing to its habit of coming out only at night, or at least in the twilight. They may then often be disturbed from the ground in a country road, when they take to flight in a heavy manner, often making a flapping noise, which appears to be caused by bringing the wings sharply together above the body of the bird. The call-note may be described as "churring," and is disagreeable in sound; it is generally uttered by the Goatsucker when sitting on a low branch of a tree or on a railing. It should be mentioned that the Caprimulgidæ do not, as a rule, sit crosswise on a branch, but always along the latter; their favourite haunt, however, is generally the ground, and it is supposed by some naturalists that the curious pectinated claw is used by the Goatsucker for scratching the ground. Dr. Günther, F.R.S., who kept one of these birds alive, says that it frequently used its comb-like claw for this purpose. Other people have thought that its claw was intended for clearing away the *débris* of moths and other insects, which would clog the bristles on the bill. The true use of this comb-like appendage on the foot has not yet, however, been thoroughly determined.

FOOT OF THE COMMON GOATSUCKER.

THE ELEVENTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS. THE SWIFTS (*Cypselidæ*).

These birds, with the Humming-birds, are separated from the other Fissirostral *Picariæ* by many anatomical characters, the chief being the arrangement of the feather-tracts on the body, which are quite peculiar; the muscles are also unlike those of the other families, and hence these two groups are often divided off by modern naturalists under the name of *Macrochires*.*

THE COMMON SWIFT (*Cypselus apus*).†

In the beginning of May the Common Swift comes to Great Britain and the rest of Europe, after passing his winter sojourn in South Africa. He is one of the latest arrivals, as he comes only when summer has fairly begun and fine weather is pretty well assured; again, in autumn, he is almost the first of the summer migrants to take his departure, and the absence of the Swifts from their accustomed haunts is a sure sign of the approach of the fall of the year. So incumbent does this early migration seem to be upon the species, that the Swifts have been known to leave their young to perish of starvation rather than delay their departure if cold weather suddenly

* μακρός, long; χείρ, a hand, in the sense of a wing of a bird.

† Cypselus, a swift; *a*, not; πους, a foot.

approaches. All birds appear to have at times a failure of instinct, and the Swift is no exception to the rule, for sometimes they are caught in some cold weather on their arrival, and it is not uncommon to find them benumbed with cold, and fluttering helplessly or even lying dead on the ground. In this latter position they are peculiarly helpless, their little legs being unable to raise them so as to give them the proper momentum to rise into the air again, while their long wings are much in the way, and only assist in their entire discomfiture. The home of the Swift, then, is in the air, and here his evolutions are most rapid, and performed with extreme quickness and yet with consummate ease. For his breeding home he often selects water-spouts on lofty buildings, such as the English cathedrals, or else places his nest under the roofs of houses, to the edge of which he is able to shuffle, and then to launch himself suddenly down, after which his course is easy. In the evening there is generally a little gathering of Swifts together, when they fly screaming round and round the buildings in which their nests have been placed, separating again for a few moments to rejoin in an excited flock, which passes with incredible swiftness and much noise round the edges of the towers or homesteads. When about to migrate, however, they are silent, and the flocks which may be seen coursing along the sides of the downs in the southern counties of England in August utter no sound, as if impressed with the gravity of the long journey they are about to undertake.

COMMON SWIFT.

Macgillivray describes the nest of the Common Swift as follows:—"It is very rudely constructed, flattened, about six inches in diameter and half an inch thick; composed of particles of Aira cæspitosa, straws of oats, wheat, and grasses, intermixed with fibrous roots, moss, wool, cotton, hair, and feathers of the domestic fowl, partridge, and rook. These materials are confusedly felted and agglutinated, the glueing matter being of a gelatinous, not of a resinous, nature, and in extremely thin shreds, which crackle, but do not readily burn, when flame is applied to them. There is, however, a small quantity of the membranous scales of the Scotch fir, together with some resinous matter, in one of these nests." The eggs are generally two in number, of a long oval shape, and entirely white.

Swifts appear to be found all over the world, the most graceful being perhaps the Tree Swifts (*Dendrochelidon*), which inhabit India and the Malayan region. In this same part of the world are also found the Edible-nest Swiftlets (*Collocalia*), which breed in caves, their nests being eaten by the

Chinese and other Asiatic people. Dr. Jerdon says:—"The nest, when pure and of the first make, is composed entirely of inspissated mucus from the large salivary glands of the bird. It is very small, bluntly triangular in form, and slightly concave within; of a semi-transparent, fibrous sort of texture, bluish-white in colour, and with the fibres, as it were, crossed and interlaced. When the nests of the first make are taken away, the second nests are mixed with feathers, and occasionally other foreign substances. The eggs are two in number, and pure white." Mr. E. L. Layard gives the following account of a visit to a cave inhabited by the Indian Swiftlet in Ceylon:—"I have at last visited the

TREE SWIFT.

cave in which *Collocalia nidifica** builds, and will now, with the aid of my journal, give all the information I can, sending you birds skinned and in spirit, and a young nestling taken from the nest with my own hand. The cave is situated at a place called Havissay, about thirty-five miles from the sea and twenty from the river, and about 500 feet up a fine wood-clad hill, called Dingallagoolawa, or Hoonoomooloocota. Its dimensions are as follows:—Length between fifty and sixty feet, about twenty-six broad, and twenty high. It is a mass of limestone rock, which has cracked off the hill-side, and slipped down on to some boulders below its original position, forming a hollow triangle. There are three entrances to the cave; one at each end, and one very small one in the centre. The floor consists of large boulders, covered to the depth of two or three inches with the droppings of the birds, old and young, and the bits of grass they bring in to fabricate their nests. The only light which penetrates the cavern from the entrances above mentioned is very dim. When my eyes, however, got accustomed

* Nest-building.

EDIBLE-NEST SWIFTLETS.

to the light, I could see many hundreds of nests glued to the side of the fallen rock, but none to the other side, or hill itself. This I attribute to the fact of the face of the main rock being evidently subject to the influence of the weather, and perhaps to the heavy dews off the trees; but for this, the side in question would have been far more convenient for the birds to have built on, as it sloped gently outward, whereas the other was much overhung, and caused the birds to build their nests of an awkward shape, besides taking up more substance. I was at the spot a few days before Christmas, and fancy that must be about the time to see the nests in perfection. This is corroborated by the fact of my finding young birds in all the nests taken by me, and by what the old Chinaman said, that the 'take' came on in October. I find that they have three different qualities of nests, and send two for your inspection. The best is very clean, white as snow, and thin, and is also very expensive. The most inferior are composed of dry grasses, hair, &c., but I could not detect anything like the bloody secretion, as described ('though only under peculiar circumstances of exhaustion') by Mr. Barbe, even in a fresh nest. I was in the cave late (after 5 P.M.) in the evening of a day which threatened rain, but the old birds were still flying round the summit of the mountain at a vast altitude, occasionally dashing down into the cave with food for their nestlings. By daylight next morning I was on foot, but the birds were before me, hawking on the plain below and all about the hills. I have found the birds here, in Colombo, in Kandy, and all along the road we went. I could learn nothing of the number of eggs laid, nor of their colour. I found one bird in each nest. The Chinese who live on the spot pretend not to understand anything asked them, and the apathetic Cingalese have never taken the trouble to see for themselves, so they could give me no information. The aspect of the country, broken and rugged, coupled with the numerous flocks of birds I saw flying round the various hills, leads me to think there must be many breeding-places yet undiscovered. One, however, was pointed out, but we had not time to visit it. I could not hear of any other kind of *Swift* breeding there, but have just received such information as leads me to suppose that *C. fuciphaga* builds near Jaffna on some rocks overhanging the sea. I may further add that there were no Bats in the cave with *C. nidifica*, nor did I see any bird of prey, save a fine *Hæmatornis*, which I shot. The Cingalese name for *C. nidifica* is *Wahlœna*."

WHITE-THROATED SPINE-TAILED SWIFT.

THE TWELFTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.—THE HUMMING BIRDS (*Trochilidæ*).

These exquisite little creatures are perhaps the largest family of birds known, numbering, at the present day, nearly five hundred species. It is simply impossible in a work like the present to de

more than allude to a family, the full description of which by Mr. Gould has occupied five large folio volumes. An immense variety of form and colour is presented to us. All the birds are of small size, some of them being no larger than Hawk-moths, to which in their manner of flight they bear considerable resemblance.

In some countries Humming-birds are tolerably common, but some species are of extreme rarity, such, for instance, as the *Loddigesia mirabilis*, which was discovered forty years ago, and still remains

SWORD-BILL HUMMING BIRD.

represented by a single specimen in the collection of the late Mr. George Loddiges, and of which a reward of fifty pounds, offered by Mr. Gould, has not succeeded in obtaining a second example. As a rule, Humming-birds are a Neotropical family, that is to say, the vast majority of the species occur in South America, and do not wander above the line of Northern Mexico; but a few species are found in the Southern United States, while one occurs in summer even in North America, ranging as far as, and even breeding in, Canada. Professor Newton writes:—"Wilson, Audubon, Mr. Gosse, and several others gifted with 'the pen of a ready writer,' have so fully described, as far as words will admit, the habits of different members of the family *Trochilidæ*, that it is unnecessary to say much on this score. Their appearance is so entirely unlike that of any other birds that it is hopeless to attempt

in any way to bring a just conception of it to the ideas of those who have not crossed the Atlantic; and even the comparison so often made between them and the *Sphingidæ*, though doubtless in the main true, is much to the advantage of the latter. One is admiring the clustering stars of a scarlet *Cordia*, the snowy cornucopias of a *Portlandia*, or some other brilliant and beautiful flower, when between the blossoms and one's eye suddenly appears a small dark object, suspended as it were between four short black threads meeting each other in a cross. For an instant it shows in front of the flower; an instant more it steadies itself, and one perceives the space between each pair of threads occupied by a grey film; again another instant, and, emitting a momentary flash of emerald and sapphire light, it is vanishing, lessening in the distance as it shoots away, to a speck that the eye cannot take note of—and all this so rapidly that the word on one's lips is still unspoken, scarcely the thought in one's mind changed. It was a bold man or an ignorant one who first ventured to depict Humming birds flying; but it cannot be denied that representations of them are often of special use to the ornithologist. The peculiar action of one, and probably of many or all other species of the family, is such, that at times in flying it makes the wings almost meet, both in front and behind, at each vibration. Thus, when a bird chances to enter a room it will generally go buzzing along the cornice. Standing beneath where it is, one will find that the axis of the body is vertical, and each wing is describing a nearly perfect semicircle. As might be expected, the pectoral muscles are very large; indeed, the sternum of this bird is a good deal bigger than that of the common Chimney Swallow (*Hirundo rustica*). But the extraordinary rapidity with which the vibrations are effected seems to be chiefly caused by these powerful muscles acting on the very short wing-bones, which are not half the length of the same parts in the Swallow; and accordingly, great as this alar action is, and in spite of the contrary opinion entertained by Mr. Gosse, it is yet sometimes wanting in power, owing, doubtless, to the disadvantageous leverage thus obtained; and the old authors must be credited who speak of cobwebs catching Humming birds. On the 3rd of May, 1857, a bird of this species flew into the room where I was sitting, and after fluttering for some minutes against the ceiling, came in contact with a deserted spider's web, in which it got entangled, and remained suspended and perfectly helpless for more than a minute, when by a violent effort it freed itself. I soon after caught it, still having fragments of the web on its head, neck, and wings; and I feel pretty sure, that had this web been inhabited and in good repair, instead of being deserted and dilapidated, the bird would never have escaped."

WHITE-BOOTED RACKET TAIL.

Mr. A. R. Wallace has written the following account of the habits of Humming birds on the River Amazon:—"The greater number of species that frequent flowers do so, I am convinced, for

the small insects found there, and not for the nectar. In dozens, and perhaps hundreds, of common flower-frequenting species which I have examined, the crop, stomach, and intestines have been filled with minute beetles, ants, and spiders, which abound in most flowers in South America. Very rarely indeed have I found a trace of honey or of any liquid in the crop or stomach. The flowers they most frequent are the various species of *Inga* and the papilionaceous flowers of many large forest trees. I have never seen them at the bignonias, or any flowers but those which grow in large masses, covering a whole tree or shrub, as they visit perhaps a hundred flowers in a minute and never stop at a single one. The little Emerald Hummer I have seen in gardens and at the common orange (*Asclepias*), which often covers large spaces of waste ground in the tropics. But there are many, such as *Phaëthornis eremita* and some larger allied species, which I

COMMON TOPAZ HUMMING BIRD.

have never seen at flowers. These inhabit the gloomy forest-shades, where they dart about among the foliage; and I have distinctly observed them visit in rapid succession every leaf on a branch, balancing themselves vertically in the air, passing their beak closely over the under surface of each leaf, and thus capturing, no doubt, any small insects that may be upon them. While doing this, the two long feathers of the tail have a vibrating motion, apparently serving as a rudder to assist them in performing the delicate operation. I have seen others searching up and down stems and dead sticks in the same manner, every now and then picking off something, exactly as a Bush Shrike or Tree Creeper does, with this exception, that the Humming-bird is continually on the wing. They also capture insects in the true Fissirostral fashion. How often may they be seen perched on the dead twig of a lofty tree—the station that is chosen by the tyrant Flycatchers and the Jacamars—from which, like those birds, they dart off a short distance, and after a few whirls and balancings return to the identical twig they had left. In the evening, too, just after sunset, when the Goatsuckers are beginning their search after insects over the

rivers, I have seen Humming birds come out of the forest and remain a long time on the wing—now stationary, now darting about with the greatest rapidity, imitating in a limited space the evolutions of their companions the Goatsuckers, and evidently for the same end and purpose."

Wilson, the poet-naturalist, observes of the North American species as follows:—"Nature in every department of her works seems to delight in variety, and the present subject is almost as singular for its minuteness, beauty, want of song, and manner of feeding, as the Mocking Bird is for unrivalled excellence of note and plainness of plumage. This is one of the few birds that are universally beloved, and amidst the sweet dewy serenity of a summer's morning his appearance amongst the arbours of honeysuckles and beds of flowers is truly interesting.

"'When morning dawns, and the blest sun again
Lifts his red glories from the Eastern main,
Then through our woodbines, wet with glittering dews,
The flower-fed Humming bird his round pursues;
Sips with inserted tube the honied blooms,
And chirps his gratitude as round he roams;
While richest roses, though in crimson drest,
Shrink from the splendour of his gorgeous breast,
What heavenly tints in mingling radiance fly!
Each rapid movement gives a different dye:
Like scales of burnished gold they dazzling show,
Now sink to shade, now to a furnace glow.'"

CRESTED HUMMING BIRD.

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BIRDS OF PARADISE.

CASSELL'S

NATURAL HISTORY

EDITED BY

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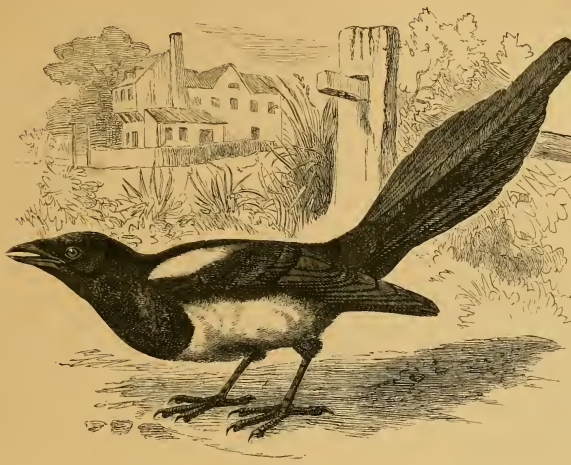


MAGPIE.

ORDER III.—PASSERIFORMES—THE PERCHING BIRDS.

CHAPTER I.

CROWS.

Order of Perching Birds largest of all Orders—Chief Distinguishing Features—Two Great Sections of Passerine Birds—Distribution—*SECTION ACROMYODI*—Classification by Wing—Sub-order TURDIFORMES—THE CROWS—Distribution—THE COMMON ROOK—Appearance—Young Rook—Bare Face—Distribution—Breeding Habits—Attachment to Nesting-places, or "Rookeries"—Is it a Useful Bird?—Its Vigorous Appetite—THE TRUE RAVENS—Distribution—THE COMMON RAVEN—Ravens of the Old and New World—Distribution—Habits—His After-Dinner Talk—THE COMMON JACKDAW—Social Character—Cleverness—Appearance—Habitat—Curious instance of Daubing its Eggs—THE HOODED CROW—Distribution—A Migration—Heligoland and its Inhabitants—THE CARRION CROW—Distribution—Inter-breeding with the Hooded Crow—Mr. Lumsden's Note on the Subject—Mr. Seebohm's Note on the Birds in Eastern Siberia—Habits—THE INDIAN GREY-NECKED CROW—Captain Vincent Legge's Account of its Habits—THE COMMON MAGPIE—Mischievous Habits—Familiarity—Instances of Nesting in Gooseberry Bushes—Appearance—THE TREE PIES—THE INDIAN TREE PIE—THE COMMON JAY—Its Bad Character—As a Pet—Appearance—THE BLUE JAYS—THE COMMON BLUE JAYS—THE LONG-TAILED BLUE JAYS—THE BARE-NECKED CROW—THE HUIA, OR NEW ZEALAND WOOD CROW—Curious Form—Dr. Buller's Account—Its Habitat—Rarity—Disposition—How Specimens were Caught—Diet—How they Searched for Food—Second Sub-family of the Crows—CHOUGHS.

THE order of Perching Birds, known to our readers by the names of Passerine birds, or Insessores, is the largest of all the orders, and contains more than half of the whole number of birds now known. One of the chief distinguishing features of a Passerine bird is its foot, which is simple and ordinary in construction, with well developed toes and claws, the claw of the hind toe being larger than that of any of the other toes. The breast-bone, or sternum, is simple, having only one notch in the hinder margin: and in this respect it differs at once from that of all the Picarian birds which have been treated of in the preceding

chapters. The eagerness with which, up to the present time, the feet of birds have been seized upon as of primary importance in their classification can hardly be wondered at, when the remarkable diversity in regard to these organs exhibited by the different orders of birds is taken into consideration. In the case of an Eagle, for instance, what can be more admirable than the proportions of the feet and talons for the capture of its quarry! And the same holds good with all the *Accipitres*, or birds of prey, not to mention the Zygodactyle Woodpeckers, which have been already discussed, while the long toes of the Rails, the webbed feet of the Ducks and Gulls, are all indications of a perfect adaptability of these organs to the habits of the birds. The Passerine birds are divided into two great sections, which are called *Passeres acromyodi* and *Passeres mesomyodi*, from peculiarities in their voice organs, the first section containing the songsters of the world, the second containing the songless birds.

SECTION A.—ACROMYODI, SINGING BIRDS. SUB-ORDER I.—TURDIFORMES, THRUSH-LIKE BIRDS.

Geographical distribution also helps to distinguish these two leading groups of the Perching birds: for the *Acromyodian Passeres* are chiefly inhabitants of the Old World, as the *Mesomyodian Passeres* are of the New. The principal character by which the leading groups are distinguished is the wing, and the classification based on this feature, which is easy to understand, will be the one adopted in the present work. The first group bears the name of *Turdiformes*, or Thrush-like *Passeres*, and in all these birds the wing has ten primary feathers, the first being always markedly reduced in size. The leading group of these birds is known as the *Coliomorphæ*, or Crow-like birds, and contains five families: Crows (*Corvidæ*), Birds of Paradise (*Paradisiidæ*), Orioles (*Oriolidæ*), Drongos (*Dicruridæ*), and Wood-Shrikes (*Prionopidæ*). All the members of these five families have the chin-angle (*angulus menti*) produced very far forwards (B), so as to extend beyond a line drawn perpendicularly down the front edge of the nostril (A). What is meant is shown in the accompanying illustration. It is true that in some of the Jays this prominence of the chin-angle is not so marked, but still sufficiently so to determine that they are Crows; while some Creepers (*Certhiidæ*) have the same character of bill, but then their long curved beaks and spiny tails prevent their being mistaken for any of the Crow family or its allies.

HEAD OF ROOK.

THE FIRST FAMILY OF THRUSH-LIKE PERCHING BIRDS.—THE CROWS (*Corvidæ*).

These are found nearly all over the globe in some form or other; that is to say, either as Crows or as Jays, the latter predominating chiefly in South America, where no true Crow is met with; and in most of the Pacific Islands no member of the family at all is found. Even the deserts of Central Asia have their own representatives in the form of Desert Choughs, belonging to the genus *Podoces*, while nowhere is the family more strongly developed than in the islands of the Malay Archipelago.

The habits of many of the Crows change with the localities they inhabit, and a species will be wild and unsociable in one place, while in another the same bird will be tame and confiding; and although in England the Crows, with the exception of the Rook and Jackdaw, live only in country districts, species precisely similar in habits and appearance are found in other parts of the world, inhabiting towns and doing the duty of scavengers.

The Choughs are peculiar Crows, distinguished by the position of the nostril, which is placed low in the upper mandible of the beak and generally hidden by a tuft of bristly feathers. They are to be considered as belonging to a separate sub-family (*Fregilinæ*). The rest of the Crows are placed in the sub-family *Corvinæ*

SUB-FAMILY CORVINÆ.

In this sub-family is found a great diversity of form, as it contains, besides the true Crows, all the Jays, Magpies, Hill Crows, and even such apparently different birds as the Huia bird and Wattle Starling of New Zealand.

THE COMMON ROOK (*Trypanocorax frugilegus*).

To any one who has not handled a Rook it would perhaps be a matter of surprise, on his first acquaintance with it in person, to find it such a handsomely burnished bird, for in the distance its appearance is dull black. Both male and female, however, have a most beautiful gloss of purple and green on the plumage, but this they share with many others of the Crow family; one peculiarity they have for their own, and that one is their bare face. How the bird gets its visage denuded of plumes is a problem still unsolved, for the young have the head fully feathered, and only obtain the bare face during their first winter. Up to this time a young Rook might easily be mistaken by an inexperienced eye for a Carrion Crow, but the Rook can be recognised at any age by its having the base of the feathers *grey*, and not *white*, as in the latter species. An idea

COMMON ROOK.

prevalent amongst naturalists for many years was that the Rook's face became denuded of feathers through the bird's habit of thrusting its bill deep into the ground in search of food, but that this cannot be the case is proved by the fact that no such result is found to occur in allied species of similar habits, such as the Carrion Crow, for instance; while it is certain that at times, when the hardness of the ground prevented the Rooks digging for food, these bare places would be replenished by a new stock of feathers: and this we know not to be the case. This bare face, then, must be considered to be an individual peculiarity in the Rooks, and it is found, though not to the same extent, in the Chinese Rook (*Trypanocorax pastinator*).

The Rook is found all over Europe, but does not extend into the high north, and only occasionally straggles beyond the line of the Tropic of Cancer. It breeds throughout Central Europe between 60° and 40° N. lat., and above the former line it rests only in certain portions of Norway and Sweden and near Archangel. To Southern Europe it is only a winter visitant, and it is found in North-western India in the winter also. In some parts of North-western Turkestan it breeds, but is found in Yarkand only in the winter. To the eastward of this last locality we have no trace of it, and it is not until we come to Eastern Siberia and Northern China that we meet with its cousin, the Chinese Rook.

It differs from its European congeners in being gregarious and always breeding in colonies. It evinces great attachment to its nesting-place, and the same nests are used by the birds year after year, being repaired each season. It is an early breeder, beginning to make ready the nest in February or March, and it has been known to commence the repairs as early as the 16th of the former month. It

is essentially a civilised bird, and rookeries are generally found in close proximity to houses, and often in the midst of villages or even towns. This is the case in London itself, where a time-honoured spot may here and there be found to which the Rooks resort year after year.

Opinions are divided as to the utility of the Rook; in some places the bird being regarded as a benefactor, in others as a depredator, only fit to be shot and trapped along with other vermin. The truth probably lies between these two opinions, for although it eats an immense number of noxious insects and grubs, it will devour eggs and young birds, while there is no question as to its creating considerable havoc among the trees in the spring-time, when it breaks off large numbers of young boughs wherewith to build its nest; in the south of England, too, in the autumn, it often commits great depredations among the walnuts. As an example of the omnivorous qualities of the Rook we quote the following note, contributed by Mr. Cecil Smith to Mr. Dresser's "Birds of Europe:"—"Its appetite and digestion are perfectly astonishing; nothing seems to come amiss to it. Besides its lawful and useful food of grubs, worms, &c., I have seen it kill and eat a young Rabbit, and young Ducks or Ducks' eggs have no chance; it will devour flesh, either fresh or stale, raw or cooked, and walnuts in any quantity. Near the sea I have seen Rooks picking up and eating Sand-Eels and other small fish after the seine has been drawn, and squabbling with the Gulls for Mussels on the Mussel-beds; these it breaks in the same way as the Gulls, taking them up to a height and dropping them on a hard, stony place. I have seen it treat an obstinate walnut in the same way. Rooks seem occasionally to cast up pellets of the indigestible portion of what they have eaten, after the manner of Hawks; so I suppose their digestion is not quite equal to everything. One of these pellets which I saw a Rook cast up, and which I examined, consisted of stones, hard parts of beetles, and husks of corn. So necessary are stones to help digestion that old Rooks give them to their young before they leave the nest, and I have frequently found them in the stomachs of young Rooks shot in the Rook shooting time, and before they had left their native tree."

THE TRUE RAVENS (*Corvus*).

The most familiar species of Raven is the Common Raven, and it is also the most widely distributed. Some six other species are known: one of them, the Brown-necked Raven (*C. umbrinus*), being an inhabitant of the Mediterranean sub-region. This division of the earth comprises all the countries lying on both sides of the Mediterranean Sea, and includes Palestine and Syria, Persia and Beloochistan, as far as the confines of North-Western India. Although belonging to the Palæarctic region, the above-named sub-region forms a very natural division, and is principally characterised by the presence of many Chats and Sand-Grouse, which do not occur in the more northern parts of the Old World. The islands of Madeira and the Canaries are considered, zoologically, to form an outlying part of the Mediterranean region, and they show a partial connection with the rest of Europe in the possession of a typical Bullfinch (*Pyrrhula murina*), while their zoological affinity to Algeria and Northern Africa is demonstrated by their having the same Blue Titmouse (*Parus teneriffæ*) and the same Raven (*Corvus leptonyx*).

In India a small form of Raven (*Corvus culminatus*) occurs, and another in Australia.

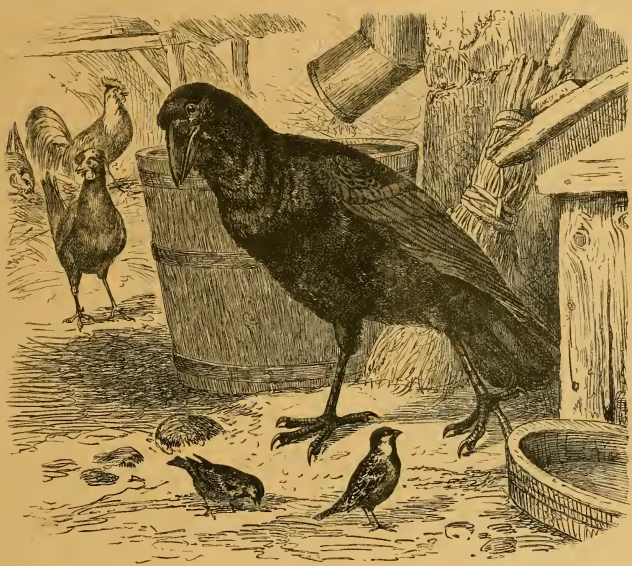
THE COMMON RAVEN (*Corvus corax*).

There are certain birds, which are found in the northern regions of the Old and New Worlds, showing the strong under-current of affinity which exists between the Avifauna of these two parts of the globe. Some ornithologists have attempted to prove that the American Raven is specifically distinct from the European one, and the Mexican bird has even been separated further from that of North America. But it seems to be an undoubted fact that the Raven is extremely variable in size, and as this is the only character which has been brought forward for its specific separation, no certain distinctions can be drawn; and in this work all the various kinds of Raven, with the exception of those above noted, are treated as belonging to one species only (*Corvus corax*).

The Raven enjoys the credit of being the most northerly Passerine bird known, with the exception of the Snow Bunting (*Plectrophanes nivalis*); for Captain Fielden observed it, in Sir George Nares' Arctic Expedition, as far north as Cape Lupton, lat. 81° 44′ N., when a pair of them were breeding during the month of July. All over Europe and Siberia, as well as Central Asia, the Raven is found in smaller or larger numbers, and in the cold weather it is found in North-Western India, being absent in China

and Japan. It is also spread all over North America as far as the table-lands of Mexico, occurring even in the extreme north of the continent. In England the Raven is in most parts scarce, and is everywhere shy and cautious, on account of the persecution to which it is subjected and the way in which nests are robbed of the young for sale, partly from its predatory habits, which render it objectionable to gamekeepers.

In some parks where protection is afforded to the old birds a time-honoured pair of Ravens still survive, and along the cliffs of the southern coasts of England a good many still breed. Although



COMMON RAVEN.

such a shy bird in many parts of its range, it exhibits in some places quite an opposite nature; and Dr. Henderson, the naturalist of the first Yarkand expedition, says that Ravens followed the camp during the whole journey, and were so familiar and bold as to render it impossible to leave anything eatable about which they did not attempt to steal. He writes:—"Even milk-pots it would deliberately upset to obtain a sup of the contents. At the greatest altitudes and through the most absolute deserts at least half-a-dozen accompanied the camp, some, doubtless, of the very same birds thus travelling the whole way from Lé to the vicinity of the city of Yarkand; when the camp divided, about half the Ravens went with each party. On first starting in the morning they always accompanied the party to a short distance, and then they returned to the old camping-ground, apparently to make sure that nothing eatable had been left behind, and there they might be seen prowling about wisely for an hour or so, again joining the party in the afternoon at the new camp." Very much the same account is given of the Raven's habits in America, where in some parts of the country it is suspicious and wary,

in other parts tame and familiar. The only note which the bird utters, as a rule, is a hoarse croak; and the idea of its having a song would seem to be impossible, but the testimony of many observers agrees in this respect. Dr. Elliott Coues says that it is not, on the whole, so noisy a bird as the Crow, though he croaks vigorously on occasions, and his caw may claim to be impressive, if not agreeable. But the queer sounds that the bird can utter, if he be so minded, are indescribable; even his ordinary cawing is susceptible of considerable modulation. A favourite amusement of his when, his hunger appeased for the time, he feels particularly comfortable, is to settle at ease on the top of a pine-tree and talk to himself. The performance generally begins with a loud caw, self-asserting, and ends with a complacent chuckle; and then comes a series of comical syllables, so low as to be scarcely audible from the ground below, as if he were musing aloud and tickled with his own fancies. Then he will raise his voice again, and file away at some old saw for a while, finishing with the inimitable "cork-drawing" for which his tribe is famous. The Raven generally breeds in trees or rocks, but he modifies the position of the nesting-place; and a good observer in California—the late Dr. Heerman—states that while he always found the nests of the Raven placed high on bold precipitous cliffs, secure against danger, in the vast desert plains of New Mexico he saw these birds building on low trees, and even on cactus plants less than three feet from the ground, showing how much circumstances and localities affect the habits of birds regarding incubation.

THE COMMON JACKDAW (*Colœus monedula*).

Although the smallest of the British *Corvidæ*, the Jackdaw may be considered the most sociable of all: for while the Rook takes up its abode during the breeding season in colonies in the midst of villages and parks, the Jackdaw, when unmolested, may be found in the very centre of towns at all seasons of the year. His cleverness and precocity render him a very favourite pet, and he may often be seen hanging in a cage outside some village cottage, or imprisoned in the dark precincts of a London costermonger's abode. For ourselves, we never could find it in our heart to cage our tame Jackdaws, and all our numerous pets were brought up from the nest, and, as soon as they were able to feed themselves, were allowed their liberty. Acting on this plan, we have sometimes had a dozen tame Jackdaws about the house, all of whom would come for food when called, betaking themselves for the greater part of the day to the fields and woods. A Jackdaw, when feeding at his ease, presents a very stately appearance, walking about with a dignified air, with the feathers of the head and neck ruffled up; on being alarmed or startled, he immediately becomes preternaturally sleek, every feather falling close to the body of the bird, and giving him quite a changed aspect. It is in this attitude that he is mostly represented in museums; and it was only recently that we discovered that the ruffled appearance of the Jackdaw's head in life is produced by folds of skin upon the crown, which, unless carefully preserved in the mounted specimen, is sure to convey an unnatural impression of the bird.

The Jackdaw is found nearly all over Europe, and in most parts of the British Islands appears to be a thoroughly resident bird. In many parts of the Continent, however, he is migratory; and we well remember seeing a large flock of over a hundred individuals pass over the island of Heligoland, where, however, it was not nearly so common as the Hooded Crow. In old cathedral towns, both in England and on the Continent, the Jackdaw is a familiar object, as it particularly affects towers and old buildings for the purpose of breeding. On the sea-shore it breeds in the cliffs in large numbers. Throughout England, however, it as frequently nests in the holes of old trees, which it occupies year after year. In Mr. E. Shelley's park at Avington, in Hampshire, the Jackdaws occupy a group of elm-trees covered with ivy, where as many as a dozen pairs breed in company with Starlings and Stock Doves. In this same locality we once saw a huge nest exposed to the air, and built on the ledge of an unused window of a shed. The eggs vary from four to seven in number, and are somewhat more bluish in general character than those of the other British Crows. They are covered with small brown blotches and dots, which are sometimes found collected at one end of the egg, sometimes distributed almost equally over its entire surface.

The following curious circumstance is related by Mr. C. B. Wharton in Mr. Dresser's "Birds of Europe":—"On the 30th of April, 1872, I took from a hole in an old elm-tree in Cassiobury Park, Herts., four eggs of this bird, which were so evenly daubed all over with clay that the shell was almost completely invisible, and the shape and weight alone told them to be eggs. The one I washed

turned out to be rather a highly-coloured egg, but of the ordinary type. I may mention that in the nest I also found a piece of hard clay (about the size of the smallest of the four eggs), with distinct marks of a bird's beak upon it. The only reason I can think of to account for this strange conduct on the part of the Jackdaw is that it may have been done to make the eggs less conspicuous to any wandering Jay, the nest being placed not far from the mouth of the hole, and the eggs, consequently, more or less in sight of a passing bird. I showed the eggs and clay to Professor Newton and others, after one of the '*Zoo*' meetings, and, if I remember rightly, you also saw them yourself; if not then, you have seen them in my cabinet, and will remember them. On the 26th of April, 1874, I took four eggs out of the very nest above mentioned, but they had nothing extraordinary about them."

Mr. Dresser adds: "I have seen the eggs above described by Mr. Wharton, and can confirm what he says respecting their being evenly and carefully daubed; and I should say that there is no doubt it was done by the bird itself, but for what reason it is impossible to say with certainty. It appears probable that it was done for the purpose of concealment."

COMMON JACKDAW.

The Jackdaw measures about thirteen inches in length, and is of a black colour, with purplish wings and tail, the back having somewhat of a greyish shade on the margins of the feathers. The crown of the head is glossy blue-black, forming a cap, while the neck is hoary grey, inclining to silvery grey near the cap, becoming somewhat whiter on the lower sides of the neck. Bill and feet black; eye bluish-white. The sexes are alike in size and plumage.

THE HOODED CROW (*Corone cornix*).

The distribution of the present species over Europe is somewhat singular, as, although it occurs in nearly every country, it cannot be said to be universally spread over the Continent, but rather appears to be distributed in colonies. Thus it is spread over the northern parts of Great Britain and Ireland, but diminishes in numbers as one approaches southward, where the common Carrion Crow (*C. hiemalis*) is the ordinary species. Indeed, throughout Europe these two species of Crow appear to be somewhat representative, the one replacing the other in different localities. In Northern Germany, for instance, the river Elbe appears to constitute a dividing line, for on the east side the Hooded Crow, and on the west side the common Carrion Crow, respectively breed. In the south of Europe the Hooded Crow is rarer, and occurs chiefly as a migrant, but the place *par excellence* where the migration of the present species can be most successfully studied is the little rocky island of

Heligoland. Here it was our good fortune to be a witness of the autumn passage of the Hooded Crow, which took place not—as one would have expected—in the direction of north to south, but from east to west. We had previously been acquainted with the species only in the British Islands, and, beyond an occasional autumn bird killed on the south coast, we had not had much opportunity for personally observing its habits. On arriving in Heligoland, therefore, we were not a little pleased on hearing that in a few days the *Nebel-krähe* might be expected, and we were informed that, if necessary, a cart-load of specimens would be easily obtainable. We had previously offered to buy specimens from the inhabitants at sixpence a head; and the supply, when once the migration had set in, fully justified our friend Mr. Gätke's experience that even a cart-load of Crows could be obtained, and our series of specimens was soon considered sufficient.

Early one morning we were taking our usual stroll along the island when we came upon a fine

HOODED CROW.

Hooded Crow lying dead upon the jacket of a peasant, whose gun, placed at the side, showed the way in which the bird had been brought down. Heligoland consists, as most of our readers will know, of a sandstone rock standing alone in the middle of the sea. The town nestles under the shelter of the eastern part of the rock; but the governor's house, and a considerable number of streets and buildings, including the church, are perched upon the eastern end of the rock itself; this being its widest part.

The rest of the island, on which there is very little depth of soil, consists of potato fields, from which, during the latter part of our stay, the Heligolanders were busily engaged in digging up their store for the coming winter. Nearly every man as he worked in his little patch of potato ground had his gun lying on the ground beside him ready for immediate use; and woe to the unfortunate Golden Plover who ventures by his whistle to betray his presence in the vicinity of the island! Most of the Heligolanders are good shots, and nearly all of them capital imitators of the notes of birds, so that we have often seen a flock of Golden Plover decoyed over the island again and again, until, perhaps, not more than one or two out of a dozen would finally escape with their lives.

The fact of it is that, with the exception of sheep which are kept for the purpose of supplying the islanders with milk, Heligoland has no animals at all upon it; hence all the meat that is consumed

there has to be brought direct from Hamburg, and hence the inhabitants are dependent to a great extent on their guns for fresh meat. Hooded Crows, therefore, are looked upon as a very useful article of food. We should be sorry to have to account for the number that were killed during the time the migration lasted, as for nearly five days a continual passage of these birds went on in a westerly direction. Scarcely had one flock disappeared in the distance than another was seen slowly heaving in sight from the eastward. Sometimes they would fly straight over the island, flapping lazily over the surface of the sea as they approached, and gradually rising to the cliffs as they neared them. The flock out of which we obtained our first specimen passed over at a height of about twenty-five feet above our heads. Very often, however, the sound of the fusillade which was continually being carried on would warn the approaching Crows, so that they would skirt the island at a safe distance, settling only for a few moments' rest on the cliffs at the western end. In such cases they were always more shy and difficult of approach.

The Hooded Crow is easily recognisable by its colours, which consist of a grey mantle and under-surface, the wings and tail, head and throat, being black. In Eastern Siberia, in Persia, and Palestine, the individuals of this species are very much paler in colour, and seem to constitute a distinct race, while on the shores of the Persian Gulf a very handsome form of Hooded Crow, named the Chaplain Crow (*C. capellana*), is met with.

Concerning the inter-breeding of *C. cornix* with *C. corone*, we have made some remarks in our notes on

THE CARRION CROW (*Corone hiemalis*).

We have already had occasion to allude slightly to the distribution of this bird and that of the Hooded Crow, which it represents in many of the countries of Europe: as, for instance, in Scandinavia, where the latter species is particularly abundant and the Carrion Crow entirely absent. In the southern parts of the British Islands the Hooded Crow as a breeding species seems to be extinct, according to the notes which have been contributed to Mr. Dresser's "Birds of Europe," but in many parts of Scotland the two species occur together and inter-breed. This curious fact—one of the most remarkable in the whole range of ornithology—is attested beyond all question by many excellent observers in Britain and on the Continent; and, as far as observations in the former have hitherto gone, the male bird generally turns out to be a Carrion Crow and the female a Hooded Crow. Such is, however, not always the case, as is evidenced by Count von Tschusi Schmidhofen in Southern Austria, who mentions an instance of a male Hooded Crow inter-breeding with a female Carrion Crow. The following note is contributed to Mr. Dresser's "Birds of Europe" by Mr. J. Lumsden, Junr.:—"On the 18th of April this year (1874) our gamekeeper told me that he had on the previous day found a Crow's nest in a high Scotch fir on the edge of a moor, and had seen both old birds flying about, one being, he was quite sure, a grey Crow, and the other a black one. Having got this information, I started off with him at once to see the nest. As we got within two gunshots of the tree the old female (Hooded Crow) flew off, and rose, croaking, above our heads. She was at once joined by the male (Carrion Crow); and as the two birds flew round us I could distinctly see that the keeper was right—that the one bird was grey and the other black. After this I visited the nest every few days, and had frequent opportunities of identifying the birds. At first the female was very wild, and left the nest long before we were within shot of her, but always soared above us in circles, getting higher and higher each time, her cries bringing the male, who invariably came in the same direction, over the shoulder of the hill at the foot of which the tree with the nest stood. After she had been sitting for some time, however, the hen became much tamer, and would not leave the nest till the tree was struck with a stick. At this time also we noticed that the male bird was shyer, and could only see him in the distance. When the young came out, she laid down eggs and rabbits' entrails near the nest; and when watching at some distance we observed that both the old birds fed the young." Mr. Dresser, having examined the specimens, adds the following note:—"The male bird is an ordinary Carrion Crow, and the female, which at the first glance appeared to be a Hooded Crow, is, I find, on closer examination, a hybrid, though approaching nearer to the Hooded than to the Carrion Crow in coloration of plumage. Two of the young birds closely resemble the mother, whereas the other two are to all appearance ordinary Carrion Crows, exhibiting none of the characters of both species which I find in other hybrids."

The author is indebted to his friend Mr. Henry Seebohm for the following account of the two birds in Eastern Siberia, the MS. notes having been kindly placed in the author's hands for the present work :—

"During the whole of our long sledge journey from Nishni Novgorod as far as Tomsk the Hooded Crow abounded on the roadsides, and in returning during the autumn I found it equally common on the banks of various rivers which the steamer navigates between Tomsk and Tobolsk and the latter town and Tyn-main. Indeed, as far as my observation goes, the whole of Russia and Western Siberia may be described as a vast colony of Hooded Crows. East Siberia, on the other hand, is an equally vast colony of Carrion Crows. From Kras-no-yarsk to Yen-e-saisk I saw nothing but the Carrion Crow. Middendorf records the same on the Tay-na and eastwards to the Sea of Okhotsk; and southwards Pjeratsky (pronounced Psheratsky) found it common in Mongolia. The distance between Tomsk and Kras-no-yarsk is about 550 versts. As you travel eastwards from Tomsk, for the first 200 versts the Hooded Crow only is to be seen. During the last 200 versts before reaching Kras-no-yarsk the Carrion Crow alone is found. In the intermediate 150 versts about one-fourth of the Crows are thorough-bred Hooded, one-fourth are pure Carrion, and the remaining half are hybrids of every stage—mulattoes, quadroons, octoroons, and so on *ad infinitum*. The line of demarcation between the two species may be roughly taken at the meridian of Calcutta, extending north of Yen-e-saisk along the valley of the Yen-e-say, and south of that town along the watershed of the Obb and the Yen-e-say. That this state of things is not of recent origin is proved by the fact that it is recorded by Middendorf, who remarked the presence of hybrid Crows at Yen-e-saisk as long ago as 1844. Hybrids between *C. corone* and *C. cornix* occur occasionally in Scotland, on the Elbe, in Turkestan, and probably wherever both species occur. The fact that these hybrids present a series of every intermediate form between the two species is *prima facie* evidence of their fertility. I succeeded, however, in getting positive evidence of this fact. On the 11th of May, whilst the ground was still covered with six feet of snow, I found a pair of hybrid Crows in possession of a nest near the top of a pine-tree. The nest contained one egg. On the 21st I climbed up to the nest again, and found it to contain five eggs. Two of these I took. On the 31st one egg was hatched and the other two were chipped ready for hatching. On the 26th of June I again climbed up to the nest, and found that one of the young birds had either died or flown. I took the other two and shot the female. She proved to be at least three-parts Carrion Crow. The feathers on the sides of the neck and on the lower part of the breast and belly are grey, with dark centres. I was unable to shoot the male, but I had on several occasions examined him through my binocular. He had more Hooded blood in him than the female, having a very grey ring round the neck, and showing a good deal of grey on the breast and under the wings.

"My total bag of Crows at the Ku-raý-i-ka was three thorough-bred Hooded, two males and a female; ten thorough-bred Carrions, nine males and one female; and fifteen hybrids, seven males and eight females. These figures, as far as they go, lead me to the conclusion that the female Carrion Crows were all breeding away in the woods, so that I rarely got a shot at one; whereas the female hybrids were most of them barren, so that I was able to shoot as many of one sex as of the other."

In the central and southern counties of England, where the author himself observed the Carrion Crow, he has always found it breeding perfectly true, and in some parts of Huntingdonshire it was by no means rare. The nest was generally placed on a high tree in the middle of a field, and was in most cases difficult of access. In Scotland it is often seen in large flocks; and Mr. Robert Gray records having seen at Findlater Castle a flock which numbered 100 each of this species and of the Hooded Crow. In Southern Europe it is gregarious, as both Von der Mühle and Lindermayer speak of it as a permanent resident in Greece, large numbers retiring to roost on the rocky islands, and returning to the mainland at break of day.

The habits of the Carrion Crow are so voracious, and the bird is altogether so cunning and unscrupulous, that he is looked on by the gamekeeper as a natural enemy. Nor can we wonder at this, when we read of the havoc which a pair of these birds will work if unmolested. We well remember visiting a little group of trees, on the estate of the Marquis of Huntley at Aboyne, from which the Crows had long since taken their departure, but beneath their nests there still remained, after a lapse of several months, the *débris* of innumerable eggs of Grouse; in fact, nothing comes amiss to its maw,

and it often kills young birds, hares, and rabbits. Macgillivray adds as its food crustacea, molluscs, grubs, and worms, mentioning that the stomach of one trapped in Linlithgowshire in November, 1834, was filled with oat seeds. Its principal food, however, is carrion, and it not unfrequently attacks sickly lambs and sheep. Mr. Hogg contributes to Macgillivray's work a detailed account of the way in which a Carrion Crow sets to work to kill the lambs and ewes, first digging out the eyes, and, as the animals open their mouth in pain, attacking and tearing out their tongue, until at last the poor creatures die from exhaustion, furnishing a good meal for the Crows and their young. The Carrion Crow will sometimes attack even living birds, as Mr. Hogg witnessed the pursuit of one after a Grouse; and Montagu states that he has seen one pursue a pigeon and strike it dead.

The present species cannot be mistaken for an adult Rook, which is easily distinguished by its bare face, but with the young of the latter bird there might be some confusion, as it has its face feathered like the Carrion Crow. It is therefore as well to state that the two birds may be distinguished by examining the base of the feathers, which are grey in a Rook and white in a Carrion Crow.

The total length of the Carrion Crow is about nineteen inches, and it is all over of a glossy steel black, with a shade of purple, the feathers of the throat being lanceolate in shape.

THE INDIAN GREY-NECKED CROW (*Corone splendens*).

This species is about the size of a Jackdaw, but is closely allied to the Hooded Crow of Europe, which it resembles in its mixture of grey on the hind neck. The following account of the bird's habits is extracted from the work of Captain Vincent Legge on the "Birds of Ceylon" (p. 350):—"He is gifted with as much as, if not more intelligence, than any member of his sagacious family; and annoying as he is, on account of his large share of brains, he is nevertheless a most useful adjunct to the sanitary regulations of Indian towns. He thrives to a marvellous degree in all these, his prosperous condition depending mainly on his utter audacity, his entire disregard of man, his thieving propensities, and his accurate powers of observation. He devotes himself to the timely occupation of the back yard, the bungalow verandah, the barrack square, the abattoir, and the commissariat meat-store, or he resorts to the scene of the fisherman's occupations on the sea-beach, or the door of the native cottage at the morning hour of cooking, in all cases exactly at the opportune moment, and he is sure not to come away without his wants being satisfied. While living at Trincomali I always found him winging his way at early morn, while it was yet dusk, in long lines to the sea-beach and to the troops' meat-store, to be in time for the dragging of the seine-net or the cutting up of the oxen; and gathering on the sands in noisy knots, or lining the branches in 'cawing' rows, these skilful robbers would never miss a chance of snatching up an unguarded morsel. But it was at meal-time in the barrack squares of Colombo that he was more particularly in his element; crowding in scores round the verandahs at the bugle-call of 'dinners up,' the audacious thieves waited until the tables were spread, and eagerly watched for the opportunity of acquiring a midday repast. Luckless was the soldier who turned his back for an instant! From the adjacent branches to the table and back was the work of a second, and in this space of time the savoury meat had disappeared from the gunner's plate and was being discussed by half-a-dozen sable beaks. In the bungalow verandah the Crow proves himself a terrible nuisance; seated on the tops of the green 'tats,' or slyly perched on the window-sill with his head awry, he does not scruple to pounce down, and in the momentary absence of the ayah snatch the bread from the children's hands, or dart into the nursery and upset the milk-jug on the table; or he will glide noiselessly through the breakfast-room window, and in an instant pounce upon the sideboard or table, and having from afar selected the most tempting-looking cutlet or the best viands, is off again before the appu, who is laying 'master's' breakfast, can, with a well-aimed blow, effectually stop the thief. The only satisfaction that 'master' gets is the appu's tale, 'Sar! I go to kitchen for a minute, and that Crow take away master's breakfast.' I have witnessed one of these birds come into the mess-room at Colombo, pull off the napkin that had been placed over a cold joint on the sideboard, and begin pecking away most vigorously at the meat.

"Concerning the Crow's exploits in Ceylon, Layard writes as follows:—'He levies contributions on all alike: leave but your breakfast-table for a moment, and as you return, the rustling of hurrying wings, the marks of many feet on the white table-cloth, the gashes in the pat of butter, and the disappearance of plantains and small viands, proclaim who have been the robbers. The old "hopper

woman" sits frying her cakes under the lonely "pandal" of her cadjan hut, and over her, with head inclined, taking a bird's-eye view of her cookery, sits the "caca;" and now the "appah" (Anglicè, "hopper") is done, lifted from the pan, and laid on the little circular basket ready for a customer. With a grunt of satisfaction the aged crone surveys her handiwork, and drops her spoon to feel for her beloved betel-pouch. A tiresome little bit of areca nut has got into a corner, and the old dame bends over it, unmindful of her charge. A dark figure drops from the roof, and though she is instantly on the alert, and aims an ineffectual blow at the thief, the nice white "appah" is borne off. Sometimes, however, the robber has but a poor hold on it, and drops it on the red cabook road. Down pounce a host of Crows that have been looking on from many a tree, and a scuffle ensues; but anxious at least to cheat them of their booty, if not to retain the damaged article for her own eating, the old woman hurries to the rescue. But this makes matters worse; the castle is defenceless, and unseen foes drop down from beam and rafter or fly in through open doors. The rice-basket is invaded, the chilli-box overturned, the dried fish stolen, and lucky is the dame if the crash of most of her little store of crockery and glass, swept to the ground and scattered in shining fragments, does not hastily recall her to her hut.'

NUTCRACKER.

"This account is by no means overdrawn, for to the natives of the bazaars the Crow is an utter pest. I question, however, whether his absence from the towns would not in the end lead to much harm, for he is a most useful scavenger, and clears the streets and back premises of everything thrown out from the houses, which would otherwise speedily decompose in the rays of the tropical sun. Notwithstanding its utter disregard for the native (which is so great that I have seen one pounce on to a basket carried on a boy's head and seize from it a cake or a fruit), it entertains a marked respect for the white man, and stands in a wholesome dread of the gun, flying off the moment a stick even is pointed at it; and so quick-sighted is it that it espies any one trying to stalk it, and decamps at once, though it has not seen the gun in the enemy's hand!

"At certain hours in the day these Crows assemble in large flocks, and hold a noisy parlance which lasts for some time. At Colombo it was usually on the beach at the 'Galle Buck,' over an evening meal on sandflies, which they are very fond of, or engaged in pranks with the hermit-crabs, that the affairs of the day seemed to be discussed. Often at midday a noisy meeting would take place on the banks of the lake, and while several dozen birds held an angry debate on some fellow Crow who was posted in the middle of the circle, others would bathe up to the thighs in the water, ducking themselves and splashing in all directions. A striking instance of the Crow's love of mischief and his innate impudence was exemplified at Colombo in his habit of annoying the unoffending little Grebes

which frequented the lake. Apparently for the sake of seeing them disappear under the water he would dart down on them over and over again.

"In the towns the Grey Crow invariably roosts on the fronds of cocoa-nut trees, sitting close together in rows, but not settling down for the night until a considerable time had been spent in noisy discussion. It appears to feel the tropical heat at midday, taking shelter under the shadiest branches, and often panting with its bill wide open."

THE COMMON MAGPIE (*Pica rustica*).

So mischievous a bird is the Magpie (see figure on p. 1) to the farmer and poultry-keeper, that it is subjected to a great amount of persecution in return for the havoc it undoubtedly commits in the poultry-yard; and it requires all its natural sagacity to defend itself and its nest and young from destruction. It is probably owing to the way in which it is shot that it has become rare in certain parts of England, especially in the well-preserved game districts. At the same time, it cannot be said to be decreasing greatly in numbers throughout the country; and we can remember to have found as many as sixteen Magpies' nests during a day's birds'-nesting in Huntingdonshire. In the parts of Berkshire, on the other hand, around Cookham and its neighbourhood, where many of our field observations have been carried on, it is decidedly a scarce species. The Magpie is generally seen in pairs, but sometimes large flocks occur. A friend, Mr. James Malham, of Iffley, informed the author that he once saw upwards of forty Magpies together in a wood in Hampshire. In other countries of Europe, such as Norway and Sweden, where the bird is looked upon with favour, it becomes very familiar, and may be found nesting close to the houses in the gooseberry-bushes. A similar instance of familiarity was communicated to Bishop Stanley by a friend, and is recorded in the "History of Birds" as follows:—"Observing, in a remote and barren part of the north of Scotland, the Magpies hopping round a gooseberry-bush, and flying in and out of it in an extraordinary manner, he noticed the circumstance to the owners of the house in which he was, who informed him that as there were no trees in the neighbourhood they had for several years built their nest and brought up their young in that bush; and that Foxes, Cats, Hawks, &c., might not interrupt them, they had barricaded not only the nest, but the bush itself, all round with briers and thorns in a formidable manner. The materials in the inside of the nest were soft, warm, and comfortable to the touch; but all round, on the outside, so rough, strong, and firmly entwined with the bush, that without a hedge-knife, or something of the kind, even a man could not, without much pain and trouble, get at their young, the barrier from the outer to the inner edge being above a foot in breadth. Frogs, Mice, or anything living were plentifully brought to their young. One day, one of the parent birds attacked a Rat, but not being able to kill it, one of the young ones came out of the nest and assisted in its destruction, which was not finally accomplished till the other old one, arriving with a dead Mouse, also lent its aid. The female was observed to be most active and thievish, and withal very ungrateful; for although the children about the house had often frightened Cats and Hawks from the spot, yet she one day seized a chicken, and carried it to the top of the house to eat it, where the hen immediately followed, and having rescued the chicken, brought it safely down in her beak; and it was remarked that the poor little bird, though it made a great noise while the Magpie was carrying it up, was quite quiet and seemed to feel no pain while its mother was carrying it down. These Magpies were supposed to have been the very same pair which had built there for several years, never suffering either the young when grown up or anything else to take possession of their bush. The nest they carefully fortified afresh every spring with rough, strong, prickly sticks, which they sometimes drew in with their united forces, if unable to effect the object alone."

The protection which the Magpie places round its nest, so as to render it a perfect *chevaux de frise*, is a necessary one, not only to guard against the depredations of the prowling birds'-nester, but also to resist the charge of small shot which the farmer or keeper relentlessly fires at any nest supposed to contain young birds. The eggs vary in number from six to eight, and are generally pale bluish-white, spotted with brown or greenish-brown. The markings vary considerably; and we remember taking a single egg from a nest in Huntingdonshire which had the larger end entirely clouded with small spots, while the following morning we found another egg on which the spots were entirely confined to the small end. The Magpie evinces considerable affection for a certain locality

during the breeding season, and several instances have been recorded of birds maimed by shot in one season returning to nest in the same place the following year.

The Magpie is about sixteen inches in length, of a glossy black plumage, slightly greenish on the crown and back, with a slightly coppery tinge on the head; across the rump a more or less distinctly marked white band; scapulas, or shoulder-feathers, white; wings blue; the primary coverts and outer web of primaries green; the inner secondaries bright blue, shading into green; all the primaries white for nearly their entire length, the tip only black; tail lustrous dark green, dusky black at the tip, before which the feathers are shaded with copper, purplish-red, or purplish-blue; throat and chest glossy black, with grey streaks on the latter; rest of under surface white; the abdomen, thighs, and under wing and tail-coverts black.

THE TREE-PIES (*Dendrocitta*).

These birds might almost be called Indian Magpies, as they form one of the genera characteristic of the Indian region. They are plentiful all over India, the Burmese countries, Southern China, and the islands of Hainan and Formosa, and extend as high as Ningpo on the Chinese coast. The presence of a Tree-pie in the last-named locality shows how the Indian Avifauna pushes its way up within the limits of the eastern Palæarctic region, which is supposed to include all China north of the river Yangtze, and many instances can be brought forward of the occurrence of truly Indian genera in Northern China and Japan. The island of Sumatra contains a very fine species of Tree-pie peculiar to itself, viz., *D. occipitalis;* and the Andaman Islands also contain a single representative, *D. bayleyi*.

In general form the Tree-pies are very like true Magpies (*Pica*), but they have the middle tail-feathers widened out at the tips in a very remarkable degree. They are noisy birds, and have a variety of notes. They build large nests of sticks, lined with leaves, fine straw, tendrils, roots, &c.

THE INDIAN TREE-PIE (*Dendrocitta rufa*).

This is the commonest and best known species, being found all over India. According to Mr. Hume, it breeds throughout the continent of India, alike in the plains and the hills, up to an elevation of 6,000 or 7,000 feet. Jerdon* states that in the plains it is most common in well-wooded districts: and in the Carnatic and bare table-land it is found only occasionally about the larger towns and in hilly jungles: but as you go farther north, it is to be seen in every grove and garden and about every village. It sometimes occurs singly, very frequently in pairs, and now and then in small parties. It flies from tree to tree with a slow, undulating flight. At times it feeds almost exclusively upon fruit, but at other times on insects, grasshoppers, locusts, mantides, and caterpillars. The natives always assert that it destroys young birds and eggs, and consider it of the Shrike genus. Mr. Smith says he "has known this bird enter a covered verandah of a house, and nip off half a dozen young geraniums, visit a cage of small birds, begin by stealing the grain, and end by killing and eating the birds, and repeating these visits daily till destroyed." Mr. Buckland stated that he had known it to enter a verandah and catch bats. It has a variety of notes: the usual harsh cry of a Magpie; a clear, whistling, somewhat metallic call, which Sundevall syllabises into *Kohlee-oh-koor*, or *Kohlee-oh*, the Bengalese into *Kotree;* and it has also a feeble, indistinct note at the pairing season, which the male utters, and the female responds to in a sort of chuckle. When several pairs are together they have a curious guttural call, which the Rev. Mr. Phillips, as quoted by Horsfield, says "sounds like *kakak*, or *keke-kak*, repeated several times." It builds a large nest of sticks, generally on lofty trees, and lays three or four eggs of a light greenish fawn-colour, sometimes with a few indistinct pale brown blotches. Buchanan Hamilton says:—"The Bengalese women imagine, whenever they hear this bird calling, that it forebodes the approach of religious mendicants, who, by partaking of the fare prepared for the family, will clean the pots used in cooking; from which circumstance its native name is derived" (Pan scraper); hence he calls it *Corvus mendicantium*, or the Beggars' Crow.

THE COMMON JAY (*Garrulus glandarius*).

The present species is by no means rare throughout Europe, and is the only Jay found until, in the neighbourhood of Constantinople and Southern Russia, it occurs along with the Black-headed Jay which replaces it to the eastward. Like all the members of the genus *Garrulus*,

* "Birds of India," Vol. I., p. 314.

it exhibits those beautiful blue and black banded feathers in the wing which have caused it to be considered one of the handsomest of British birds. It is indeed a great pity that such a beautiful species should bear such a bad character, and, what is worse, should so well deserve it. On account of its propensity for taking the eggs of game-birds, the keeper's hand is turned ruthlessly against it, and the gibbet in the preserves often shows the mouldering remains of a bright-plumaged Jay, who has atoned for his offences along with the Weasels and Stoats. According to Macgillivray, it feeds on fruit, and is particularly fond of beans and peas, but it also feeds on worms, larvæ, and snails, plunders the nests of small birds, and pounces on mice and sometimes small birds. We can ourselves vouch for its partiality to peas, for some of the earliest specimens of our acquaintance were shot in the grey dawn of the morning from a kitchen garden

COMMON JAY.

which was regularly visited by Jays for the purpose of attacking the rows of peas. This they did with great avidity, the crops of those examined being perfectly distended with the peas they had eaten.

The Jay is a favourite cage-bird, and becomes a very amusing pet; it is an excellent mimic, and has been said to imitate such sounds as the neighing of a horse, the sound of a saw, the calling of fowls, the barking of dogs, and other noises, with the greatest exactness. It is about thirteen inches in length, of a vinous red colour, becoming pale grey on the back; the rump and upper tail-coverts pure white; the tail black, washed with grey near the base, and having slight indications of bluish-grey bars; the wing-coverts are light grey, inclining to chestnut on the median series; the bastard wing and primary coverts barred with black and bright cobalt blue, as also are the outer greater coverts, the inner ones of the last series being black; quills black, the primaries washed with ashy grey, the secondaries shaded with cobalt near the shaft, and white for more than half of the outer web; the inner secondaries black, the innermost deep chestnut, tipped with black; the head is crested, the forehead being white, streaked with black; on the cheeks a broad band of black; the under

surface of the body pale vinous; the thighs whitish; and the vent and under tail-coverts pure white.

THE BLUE JAYS (*Cyanocitta*).

As we have before mentioned, the true Jays are strictly confined to the Old World, and their place is taken in America by a group of Corvine birds which are called Blue Jays. Of these, the most familiar is

THE COMMON BLUE JAY (*Cyanocitta cristata*).

Although in plumage he differs from the ordinary type of *Garrulus*, yet in his habits the Blue Jay seems to be in many respects similar. He is found over the greater part of North America, and where he is persecuted he becomes exceeding shy and suspicious; but in some parts of the United States, where protection is afforded him, he becomes quite tame and familiar, breeding close to houses and sometimes even in the streets of large towns. Thus Dr. Brewer states that in 1843 he saw a nest of this Jay filled with young in a tree standing near the house of Mr. Audubon in the city of New York. The same gentleman does justice to the utility of the Jay in the following paragraph:—"Dr. Kirtland has informed me of the almost invaluable services rendered to the farmers in his neighbourhood by the Blue Jays in the destruction of Caterpillars. When he first settled on his farm he found every apple and wild cherry-tree in the vicinity extensively disfigured and denuded of its leaves by the larvæ of the *Clisiocampa americana*, or the Tent Caterpillar. The evil was so extensive that even the best farmers despaired of counteracting it. Not long after the Jays colonised upon his place he found they were feeding their young quite extensively with these larvæ, and so thoroughly that, two or three years afterwards, not a worm was to be seen in that neighbourhood; and more recently he has searched for it in vain, in order to rear cabinet specimens of the Moth." *

In size the Blue Jay measures about eleven inches and a half, and is of a greyish-purple colour above, the crest being also of this colour; round the hind neck is a collar of black extending down to the fore neck, and across the forehead is another narrow line of black; under surface of body pale lilac brown, inclining to white on the lower abdomen and under tail-coverts; the cheeks are whitish, and the tail-feathers are broadly tipped with white, as also the greater wing-coverts and secondaries. These last few characters distinguish the Common Blue Jay from a group of allied species with black cheeks, blue on the abdomen, and no white tips to the secondary quills or tail-feathers. These are Steller's Blue Jay (*C. stelleri*), the Long-crested Blue Jay (*C. macrolopha*), and the two Mexican Blue Jays (*C. coronata* and *C. diademata*), the latter being scarcely separable as a species. The ordinary Blue Jay is spread over Canada and the northern and eastern United States. *C. stelleri* takes its place on the Pacific side of North America; from Columbia to Sitka, which in the Sierra Nevada is represented by an allied race, called by Mr. Ridgway *C. frontalis*. *C. macrolopha* is the species of the Rocky Mountains, and *C. diademata* of the highlands of Mexico.

THE LONG-TAILED BLUE JAYS (*Xanthura*).

These are also inhabitants of Central and South America, and are little known. They are all birds of variegated plumage and of handsome appearance. The tail is rather lengthened, exceeding the wing in length. It is unfortunate that the name *Xanthura* (yellow-tailed) has to be adopted for them, as some of them have the tail blue. Indeed, only four out of fourteen species can be said to possess the yellow tail; and one of these, known as the Green Jay (*Xanthura luxuosa*), penetrates into Texas, and can therefore be considered as a North American bird. From the work of Messrs. Baird, Brewer, and Ridgway we cull a short note on the last-mentioned species:—"Colonel George A. McCall, Inspector-General of the United States Army, was the first person to collect these birds within our limits. He obtained them in the forests which border the Rio Grande, on the south-eastern frontier of Texas. There he found them all mated in the month of May, and he felt no doubt that they had their nests in the extensive and almost impenetrable thickets of mimosa, commonly called chaparral. From the jealousy and pugnacity which these birds manifested on the approach, or appearance even, of the large boat-tailed Blackbirds of that country (*Quiscalus macrurus*), which were nesting in great numbers in the vicinity, Colonel McCall was satisfied that the Jays were

* "History of North American Birds," Vol. II., p. 276.

at that time also engaged in the duties of incubation and rearing their young. In character and temperament these birds appeared to be very active and lively, though less noisy than some other species of the family. Their gay plumage was exhibited to great advantage as they flitted from tree to tree, or dashed boldly in pursuit of such of their more plainly-attired neighbours as ventured to intrude upon their domain."

THE BARE-NECKED CROW (*Picathartes gymnocephalus*).

To appreciate the peculiar appearance of this Crow, it should be seen either in a living state or preserved in spirits, because the bare skin of the head loses its colour in the dried specimens. The whole head and nape are bare, but, as will be seen by the wood-cut, there is a fleshy skin, of a bright yellow colour in life, which occupies the whole of it, excepting the sides of the hinder part of the skull and the ear-hole. This yellow skin passes over the occiput and joins the hinder neck, which is covered with a few bristly feathers. The upper surface is dark grey; the throat, sides of neck, and under surface white. The home of the Bare-necked Crow is the interior of the Gold Coast, where it is found only in the forests, and being considered *fetish* by the natives, is with great difficulty procured. The examples in the British Museum were obtained by the exertions of Governor Ussher, who, during his residence on the Gold Coast, employed a most intelligent native collector to penetrate into the interior for the purpose of collecting natural history specimens. This man affirmed that the birds were found in rocky forest grounds, generally in the neighbourhood of streams, building among rocks, and feeding on fresh-water shell-fish, snails, and reptiles. The native in question also procured the nestling and the egg. The latter is like that of many other Crows, and the nestling is coloured like the adult, having the bare head, and being dark grey above, white below, with remains of nestling down.

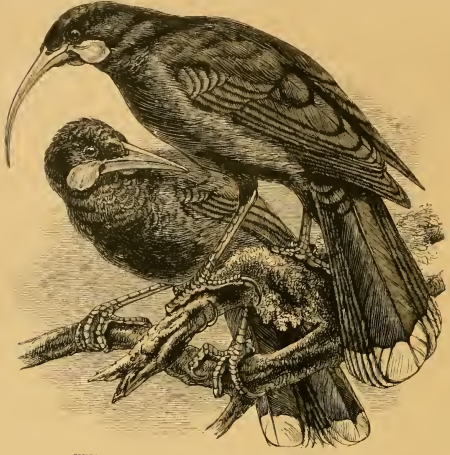
BARE-NECKED CROW. (*After Keulemans.*)

THE HUIA, OR NEW ZEALAND WOOD-CROW (*Heteralocha acutirostris*).

This very curious and aberrant Crow is a native of New Zealand, and is not found anywhere else. Even in that country it is very rare, and is becoming fast exterminated, like so many other New Zealand birds. The remarkable difference in the shape of the bill in the two sexes of the Huia led to the belief, for a long time, that these were two species; but it has since been proved that not only does the male have a very differently shaped bill from that of the female, but that this structural peculiarity serves a good purpose in the economy of the species. The best account of the Huia has been written by Dr. Buller, to whose pen we are indebted for the following extracts from his "Birds of New Zealand":—"Ere long it will exist only in our museums and other collections; and, for the sake of science, it is important that everything connected with its natural history should be faithfully recorded and preserved. In the absence of any published account of its

habits, beyond mere fragmentary notices, I have thought the subject of sufficient interest to justify my placing before the Society the following complete account of all that I have been able to ascertain respecting it. The peculiar habits of feeding, which I have described from actual observation, furnish to my own mind a sufficient 'reason' for the different development of the mandibles in the two sexes, and may, I think, be accepted as a solution of the problem.

"Before proceeding to speak of the bird itself, I would remark on the very restricted character of its habitat. It is confined within narrow geographical boundaries, being met with only in the Ruahine, Tararua, and Rimutaka mountain-ranges, with their divergent spurs, and in the intervening wooded valleys. It is occasionally found in the *Fagus* forests of the Wairarapa Valley, and in the rugged country stretching to the westward of the Ruahine range, but it seldom wanders far from its mountain haunts. I have been assured of its occurrence in the wooded country near Massacre Bay (Province of Nelson), but I have not been able to obtain any satisfactory evidence on this point. It is worthy of remark that the natives, who prize the bird very highly for its tail feathers (which are used as a badge of mourning), state that, unlike other species which have of late years diminished and become more confined to their range, the Huia was from time immemorial limited in its distribution to the district I have indicated.



HUIA, OR NEW ZEALAND WOOD-CROW. (*After Keulemans.*)

"My first specimen of this singular bird (an adult female) was obtained in 1855 from the Wainuiomata Hills, a continuation of the Rimutaka range, bounding the Wellington harbour on the northern side —the same locality from which Dr. Dieffenbach, nearly twenty years before, received the examples figured by Mr. Gould in his magnificent work, 'The Birds of Australia.' I have since obtained many fine specimens, and in the summer of 1864 I succeeded in getting a pair of live ones. They were caught by a native in the ranges and brought down to Manawatu, a distance of more than fifty miles, on horseback. The owner refused to take money for them; but I negotiated an exchange for a valuable greenstone. I kept these birds for more than a year, waiting a favourable opportunity of forwarding them to the Zoological Society of London. Through the carelessness, however, of a servant, the male bird was accidentally killed; and the other, manifesting the utmost distress, pined for her mate, and died ten days afterwards.

"The readiness with which these birds adapted themselves to a condition of captivity was very remarkable. Within a few days after their capture they had become perfectly tame, and did not appear to feel in any degree the restraint of confinement; for, although the window of the apartment in which they were kept was thrown open and replaced by thin wire netting, I never saw them make any attempt to regain their liberty. It is well known, however, that birds of different species differ widely in natural disposition and temper. The captive Eagle frets in his sulky pride; the Bittern refuses food, and dies untamable; the fluttering little Humming-bird beats itself to death against the

tiny bars of its prison in its futile efforts to escape ; and many species that appear to submit readily to their changed condition of life ultimately pine, sicken, and die. There are other species, again, which cheerfully adapt themselves to their new life, although caged at maturity, and seem to thrive fully as well under confinement as in a state of nature. Parrots, for example, are easily tamed ; and I have met with numerous instances of their voluntary return after having regained their liberty. This character of tamability was exemplified to perfection in the Huias.

"They were fully adult birds, and were caught in the following simple manner :—Attracting the birds, by an imitation of their cry, to the place where he lay concealed, the native, with the aid of a long rod, slipped a running knot over the head of the female and secured her. The male, emboldened by the loss of his mate, suffered himself to be easily caught in the same manner. On receiving these birds, I set them free in a well-lined and properly ventilated room, measuring about six feet by eight feet. They appeared to be stiff after their severe jolt on horseback, and after feeding freely on the huhu grub, a pot of which the native had brought with them, they retired to one of the perches I had set up for them, and cuddled together for the night.

"In the morning I found them somewhat recruited, feeding with avidity, sipping water from a dish, and flitting about in a very active manner. It was amusing to note their treatment of the huhu. This grub, the larva of a large nocturnal Beetle (*Prionoplus reticularis*), which constitutes their principal food, infests all decayed timber, attaining at maturity the size of man's little finger. Like all grubs of its kind, it is furnished with a hard head and horny mandibles. On offering one of these to the Huia, he would seize it in the middle, and at once transferring it to his perch, and placing one foot firmly upon it, he would tear off the hard parts, and then, throwing the grub upwards to secure it lengthwise in his bill, would swallow it whole. For the first few days these birds were comparatively quiet, remaining stationary on their perch as soon as their hunger was appeased. But they afterwards became more lively and active, indulging in play with each other, and seldom remaining more than a few moments in one position. I sent to the woods for a small branched tree, and placed it in the centre of the room, the floor of which was spread with sand and gravel. It was most interesting to watch these graceful birds hopping from branch to branch, occasionally spreading the tail into a broad fan, displaying themselves in a variety of natural attitudes, and then meeting to caress each other with their ivory bills, uttering, at the same time, a low affectionate twitter. They generally moved along the branches by a succession of light hops, after the manner of the Kokako (*Glaucopis cinerea*), and they often descended to the floor, where their mode of progression was the same. They seemed never to tire of probing and chiselling with their beaks. Having discovered that the canvas lining of the room was pervious, they were incessantly piercing it and tearing off large strips of paper, till, in the course of a few days, the walls were completely defaced.

"But what interested me most of all was the manner in which the birds assisted each other in their search for food, because it appeared to explain the use, in the economy of nature, of the differently formed bills in the two sexes. To divert the birds, I introduced a log of decayed wood infested with the huhu grub. They at once attacked it, carefully probing the softer parts with their bills, and then vigorously assailing them, scooping out the decayed wood till the larva or pupa was visible, when it was carefully drawn from its cell, treated in the way described above, and then swallowed. The very different development of the mandibles in the two sexes enabled them to perform separate offices. The male always attacked the more decayed portions of the wood, chiselling out his prey after the manner of some Woodpeckers, while the female probed with her long pliant bill the other cells, where the hardness of the surrounding parts resisted the chisel of her mate. Sometimes I observed the male remove the decayed portions without being able to reach the grub, when the female would at once come to his aid, and accomplish with her long slender bill what he had failed to do. I noticed, however, that the female always appropriated to her own use the morsels thus obtained.

"For some days they refused to eat anything but huhu ; but by degrees they yielded to a change of food, and at length would eat cooked potato, boiled rice, and raw meat minced up in small pieces. They were kept supplied with a dish of fresh water, but seldom washed themselves, although often repairing to the vessel to drink. Their ordinary call was a soft and clear whistle, at first prolonged, then short and quickly repeated, both birds joining in it. When excited or hungry, they raised their whistling note to a high pitch ; at other times it was softly modulated, with variations, or

changed into a low chuckling note. Sometimes their cry resembled the whining of young puppies so exactly as almost to defy detection."

SECOND SUB-FAMILY OF THE CROWS.—THE CHOUGHS (*Fregilinæ*).

In this sub-family, which contains only a few species, the bill is long and gently curved, and the nostrils are placed low down in the upper mandible. They are hidden by a dense tuft of bristles. In

CHOUGH.

England the sub-family is represented by the Red-billed or "Cornish" Chough, the same species which is alluded to in the old English glee—

"The Chough and Crow to roost are gone."

In Cornwall and the south-west of England the bird is no longer very plentiful, but is found on the rocky coasts of parts of Wales, the Hebrides, &c. In the mountains of Switzerland and Southern Europe the Alpine Chough (*Pyrrhocorax alpinus*) occurs, ranging as far as the Himalayas, and in Australia the sub-family is represented by the White-winged Chough (*Corcorax melanorhamphus*). A word, too, must be said about the curious Desert Choughs (*Podoces*), which inhabit Central Asia, where they are found only in the dreary sandy wastes and deserts which stretch from Bokhara to Eastern Tibet.

CHAPTER II.

BIRDS OF PARADISE—ORIOLES—DRONGOS—WOOD SHRIKES—CUCKOO SHRIKES—FLYCATCHERS.

THE BIRDS OF PARADISE—Variety of Plumage—Gaudily dressed Crows—Points in which they differ from the Crows—Two Sub-families—Mr. Wallace's Account of their Habits—Their History—The Great Bird of Paradise—The Smaller Bird of Paradise—Dr. Beccari on the Birds of Paradise of the Arfaks—THE ORIOLES—THE GOLDEN ORIOLE—Mr. Dresser's Description of its Habits—Size and Colour—THE DRONGOS—Distinctive Features—The Marquis of Tweeddale's Definition of the Family—THE WOOD SHRIKES—Mr. Gould's Account of the Pied Grallina—THE COMMON WOOD SHRIKE—THE CUCKOO SHRIKES—Habitat—Appearance—Mr. Gould on the Black-faced Cuckoo Shrike—Dr. Jerdon on the Common Indian Species—THE FLYCATCHERS—Characters—THE COMMON FLYCATCHER—Habits—THE FANTAILS—Mr. Gould's Account of the White-shafted Fantail and the Black Fantail—THE PARADISE FLYCATCHERS—THE RESTLESS FLYCATCHER.

THE SECOND FAMILY OF THRUSH-LIKE PERCHING BIRDS.
THE BIRDS OF PARADISE (*Paradisiidæ*).

WITH the exception of the Humming-birds, there is no family which embraces so many peculiar and fantastically decorated forms as that of the Birds of Paradise. Every variety of plumage is met with in them, some having extraordinary plumes on the head, others being adorned with breast-shields, while many have the flank feathers produced to an inordinate length, so as even to hide the tail-feathers in some of the species. Strip them of their gorgeous plumage, and their true affinities become at once apparent, and they stand confessed as being nothing more than gaudily dressed Crows. Some of the Birds of Paradise—such as the Manucodes (*Manucodia*), or the Brown Birds of Paradise (*Lycocorax*)—exhibit even a Corvine appearance in their plumage, the latter birds being of a plain brown and black colour; but the whole family differ from the true Crows in the proportions of their feet, the outer toe being a little shorter than the middle one and longer than the inner toe, the hind toe, at the same time, being very large, and equalling the middle one in length. The family may be divided into two sub-families, the first of which may be called the Sickle-billed Birds of Paradise (*Epimachinæ*). All of these have a long curved bill, and include the Rifle Birds (*Ptilorhis*), the Twelve-wired Bird of Paradise (*Seleucides*), and the Sickle-bills (*Drepanornis* and *Epimachus*). The second sub-family is that of the true Paradise Birds (*Paradisiinæ*). About thirty-four different kinds are known up to the present time, and the range of the family is included in a very small area: for, with the exception of the Rifle Birds and Manucodes, which are found in Australia as well as New Guinea, all the other members of the family are inhabitants of the latter island and the adjacent Moluccas, extending as far as the Batchian and Gilolo group. Science is indebted to Mr. A. R. Wallace for authentic information respecting the habits of the Paradise Birds, and the following extracts are taken from his well-known work on the Malay Archipelago. Writing in 1869, Mr. Wallace observes:—"As many of my journeys were made with the express object of obtaining specimens of the Birds of Paradise, and learning something of their habits and distribution, and being (as far as I am aware) the only Englishman who has seen these wonderful birds in their native forests, and obtained specimens of many of them, I propose to give here, in a connected form, the result of my observations and inquiries. When the earliest European voyagers reached the Moluccas in search of cloves and nutmegs, which were then rare and precious spices, they were presented with the dried skins of birds so strange and beautiful as to excite the admiration even of these wealth-seeking rovers. The Malay traders gave them the name of *Manuk dewata*, or God's Birds; and the Portuguese, finding that they had no feet or wings, and not being able to learn anything authentic about them, called them *Passaros de Sol*, or Birds of the Sun; while the learned Dutchmen, who wrote in Latin, called them *Avis paradiseus*, or Paradise Birds. John van Linschoten gives these names in 1598, and tells us that no one has seen these birds alive, for they live in the air, always turning towards the sun, and never lighting on the earth till they die; for they have neither feet nor wings: as, he adds, may be seen by the birds carried to India, and sometimes to Holland; but being very costly, they were then rarely seen in Europe. More than a hundred years later, Mr. William Funnel, who accompanied Dampier, and wrote an account of the voyage, saw specimens at Amboyna, and was told that they came to Banda to eat nutmegs, which

intoxicated them and made them fall down senseless, when they were killed by Ants. Down to 1760, when Linnæus named the largest species *Paradisea apoda* (the Footless Paradise Bird), no perfect specimen had been seen in Europe, and absolutely nothing was known about them. And even now, a hundred years later, most books state that they migrate annually to Ternate, Banda, and Amboyna; whereas the fact is that they are as completely unknown in those islands in a wild state as they are

TWELVE-WIRED BIRD OF PARADISE.

in England. Linnæus was also acquainted with a small species, which he named *Paradisea regia* (the King Bird of Paradise), and since then nine or ten others have been named, all of which were first described from skins preserved by the savages of New Guinea, and generally more or less imperfect. These are now all known in the Malay Archipelago as *Burong mati*, or dead birds, indicating that the Malay traders never saw them alive."

"The Great Bird of Paradise (*Paradisea apoda** of Linnæus) is the largest species known, being generally seventeen or eighteen inches from the beak to the tip of the tail. The body, wings, and tail are of a rich coffee brown, which deepens on the breast to a blackish-violet or purple brown. The

* *Apoda*, without feet.

whole top of the head and neck is of an exceedingly delicate straw yellow, the feathers being short and close set, so as to resemble plush or velvet; the lower part of the throat up to the eye is clothed with scaly feathers of an emerald green colour, and with a rich metallic gloss, and velvety plumes of a still deeper green extend in a band across the forehead and chin as far as the eye, which is bright yellow. The beak is pale lead blue; and the feet, which are rather large and very strong and well formed, are of a pale ashy pink. The two middle feathers of the tail have no webs, except a very small one at the base and at the extreme tip, forming wire-like cirrhi, which spread out in an elegant double curve, and vary from twenty-four to thirty-four inches long. From each side of the body, beneath the wings, springs a dense tuft of long and delicate plumes, sometimes two feet in length, of the most intense golden orange colour, and very glossy, but changing towards the tips into a pale brown. This tuft of plumage can be elevated and spread out at pleasure, so as almost to conceal the body of the bird. These splendid ornaments are entirely confined to the male sex, while the female is really a very plain and ordinary-looking bird of an uniform coffee brown colour, which never changes; neither does she possess the long tail wires, nor a single yellow or green feather about the head. The young males of the first year exactly resemble the females, so that they can only be distinguished by dissection. The first change is the acquisition of the yellow and green colour on the head and throat, and at the same time the two middle tail-feathers grow a few inches longer than the rest, but remain webbed on both sides. At a later period these feathers are replaced by the long bare shafts of the full length, as in the adult bird; but there is still no sign of the magnificent orange side plumes which, later still, complete the attire of the perfect male. To effect these changes there must be at least three successive moultings; and as the birds were found by me in all the stages about the same time, it is probable that they moult only once a year, and that the full plumage is not acquired till the bird is four years old. It was long thought that the fine train of feathers was assumed for a short time only at the breeding season, but my own experience, as well as the observation of birds of an allied species which I brought home with me to England, and which lived for two years, show that the complete plumage is retained during the whole year, except during a short period of moulting, as with most other birds. The Great Bird of Paradise is very active and vigorous, and seems to be in constant motion all day long. It is very abundant, small flocks of females and young males being constantly met with; and though the full-plumaged birds are less plentiful, their loud cries, which are heard daily, show that they also are very numerous. Their note is, '*Wauk-wauk-wauk-wōk-wōk-wōk*,' and is so loud and shrill as to be heard at a great distance, and to form a most prominent and characteristic animal sound in the Aru Islands. The mode of nidification is unknown; but the natives told me that the nest was formed of leaves placed on an ant's nest, or on some projecting limb of a very lofty tree, and they believe that it contains only one young bird. The egg is quite unknown, and the natives declared they had never seen it; and a very high reward offered for one by a Dutch official did not meet with success. They moult about January or February, and in May, when they are in full plumage, the males assembling early in the morning to exhibit themselves in the singular manner already described. This habit enables the natives to obtain specimens with comparative ease. As soon as they find that the birds have fixed upon a tree on which to assemble, they build a little shelter of palm leaves in a convenient place among the branches, and the hunter ensconces himself in it before daylight, armed with his bow and a number of arrows terminating in a round knot. A boy waits at the foot of the tree, and when the birds come at sunrise, and a sufficient number have assembled and have begun to dance, the hunter shoots with his blunt arrow so strongly as to stun the bird, which drops down, and is secured and killed by the boy without its plumage being injured by a drop of blood. The rest take no notice, and fall one after another till some of them take the alarm."

Speaking of the smaller Bird of Paradise (*Paradisea papuana*), Mr. Wallace says:—"The true Paradise Birds are omnivorous, feeding on fruits and insects—of the former preferring the small figs; of the latter, grasshoppers, locusts, and phasmas, as well as cockroaches and caterpillars. When I returned home, in 1862, I was so fortunate as to find two adult males of this species in Singapore; and as they seemed healthy, and fed voraciously on rice, bananas, and cockroaches, I determined on giving the very high price asked for them—£100—and to bring them to England by the overland route under my own care. On my way home I stayed a week at Bombay, to break the journey and to lay in a fresh stock of bananas for my birds. I had great difficulty, however, in supplying them with

insect food, for in Peninsular and Oriental steamers cockroaches were scarce, and it was only by setting traps in the store-rooms, and by hunting an hour every night in the forecastle, that I could secure a few dozens of these creatures, scarcely enough for a single meal. At Malta, where I stayed a fortnight, I got plenty of cockroaches from a bake-house, and when I left took with me several biscuit-tins full as provision for the voyage home. We came through the Mediterranean in March, with a very cold wind; and the only place on board the mail-steamer where their large cage could be accommodated was exposed to a strong current of air down a hatchway, which stood open day and night: yet the birds never seemed to feel the cold. During the night journey from Marseilles to Paris it was a sharp frost; yet they arrived in London in perfect health, and lived in the Zoological Gardens for one and two years, often displaying their beautiful plumes to the admiration of the spectators. It is evident, therefore, that the Paradise Birds are very hardy, and require air and exercise rather than heat; and I feel sure that if a good-sized conservatory could be devoted to them, or if they could be turned loose in the Tropical Department of the Crystal Palace or the Great Palm House at Kew, they would live in this country for many years."

After Mr. Wallace's return to Europe, the Dutch Government, stimulated by the successful result of his travels made in their East Indian possessions, despatched thither several excellent collectors, whose names are now household words to the ornithologist: such as Bernstein, Von Rosenberg, and Van Muschenbroek; whilst within the last few years the expeditions of Dr. A. B. Meyer, and of the Italian travellers D'Albertis and Beccari, have succeeded in making us acquainted with many species which Mr. Wallace was unable to procure, as well as in obtaining some new species of these wonderful birds. Dr. Beccari spent some time on the Arfak Mountains in North-western New Guinea, and he has written a long account of the ornithology of that wonderful region. From this essay a few sentences

GORGETED BIRD OF PARADISE.

are quoted, as they convey a very good idea of the charms which the traveller in New Guinea experiences on meeting the Birds of Paradise in a state of nature. "The Arfaks call the Gorgeted Bird of Paradise (*Astrapia gularis*) 'Haroma,' and the adult of the Great Bird of Paradise 'Kambiloja,' while the young ones and females are called 'Lessoa.' D'Albertis' Paradise Bird (*Drepanornis* albertisi*), named after the discoverer, is well known to the Arfaks under the name of 'Sagroja.' It is not very rare, but difficult to find, because, as the hunters assure me, it has no peculiar cry, so that it is only met with by chance. Its inconspicuous colour also makes it difficult to see. It is partial to places near recent clearings, from 3,000 to 5,000 feet, as it has the habit of flying to dead trees and fallen trunks, about which it finds the insects which form its food. In the stomachs of the two specimens I dissected I found only insects of various orders, ants predominating, and the larvæ of a lepidopterous insect. As to the Wattled Bird of Paradise (*Paradigalla carunculata*), I shot one from my hut while it was eating the small fleshy fruits of an *Urtica*. It likes to sit on the tops of dead and leafless trees, like Dumont's Grakle (*Mino dumonti*). The finest ornament of this bird are its wattles, which in the dried skin lose all their beauty. The upper ones, which are attached one on each side of the forehead, are of a yellowish-green colour; those at the base of the lower mandible are blue, and have a small patch of orange beneath. The Arfaks call the Paradigalla 'Happoa.' Of the Six-plumed Bird of Paradise (*Parotia† sexpennis*) I got one adult male alive, but it lived only three days. Its eye, with the iris azure, surrounded by a yellow ring, is extremely beautiful. The six feathers which ornament the head are not raised up vertically, but moved backwards and forwards in a horizontal and oblique direction, and are moved forward parallel to the sides of the beak. It is the commonest Paradise Bird on Mount Arfak; but, as usual, the adult males are much scarcer than the females and young males." "The superb Bird of Paradise is rather rarer than the *Parotia*; but I must tell you that the abundance of fruit-eating birds in a given locality depends principally on the season at which certain kinds of fruit are ripe; therefore, a species may be common in a place one month, and become rare or completely disappear in the next, when the season of the fruit on which it lives has passed. The magnificent Bird of Paradise (*Diphyllodes‡ speciosa*) is also pretty common, and easy to kill when one has learnt to know its song, which resembles a kind of *teia-teia-teia*, repeated several times with diminishing force. The sound produced by kissing the palm of the hand is a very good imitation. When once you have heard the song, if you approach carefully, especially early in the morning, you will find some small spaces, about a yard and a half in diameter, clear of sticks and leaves, where one or two males are paying court to a female. The males then erect all their feathers; the skin of the neck swells up like a bladder; the head seems like the centre of an aureola, which is formed beneath by the expanded feathers of the breast, and above by those of the yellow mantle, which are carried in a perfectly vertical position and spread like a fan. I kept a bird of this species alive for some days. It is found sometimes at a little distance from the sea on the plains, but perhaps more often on the hills, at 1,000 to 2,000 feet of elevation, preferring open spaces and the vicinity of streams."

THE THIRD FAMILY OF THRUSH-LIKE PERCHING BIRDS.

THE ORIOLES (*Oriolidæ*).

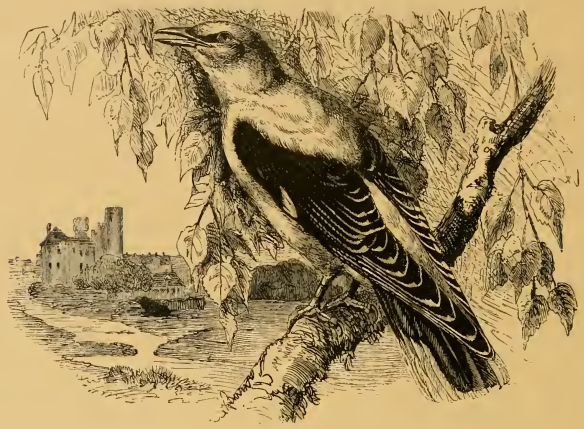
The Orioles are generally of a bright yellow colour, with black wings, which contrast with and contrive to show off the golden tints of the plumage to the best advantage. They are all inhabitants of the Old World, and must not be mistaken for the Hang-nests of America (*Icteridæ*), which often go by the popular name of Orioles also. The best known species of the family is

THE GOLDEN ORIOLE (*Oriolus galbula*).§

This species is a rare visitor to England, but many instances of its occurrence have been recorded, and on one or two occasions it has been said to breed in Britain. It is found throughout Central and Southern Europe in summer, but does not extend very far north, and departs in winter to South Africa, where it is found in the Cape Colony, and occurs also in certain places on the east coast also. It is very common in Persia during the summer, and ranges eastwards to Central Asia.

* ἀρεπάνη, a sickle; ὄρνις, a bird. † παρωτίς, a curl by the ear. ‡ δίφυλλος, two-leaved. § *galbus*, yellow.

One of the best accounts of the Golden Oriole is that given by Mr. Dresser in the "Birds of Europe," as it is a bird with which he was personally well acquainted. He observes, "The Golden Oriole is a shy and unobtrusive bird; and, in spite of its gaudy coloration, it is by no means a conspicuous or easily observed species. It affects evergreen groves and woods, where it keeps to the dense foliage, and appears to be a restless, uneasy bird, continually moving from place to place. When in Finland, now nearly twenty years ago, I had very ample opportunities of observing this species, for a pair bred in a garden, and were generally to be found in the high trees of a fine old avenue in front of the windows of the house in which I was living, and the clear bold whistle of the male and his mewing call could generally be heard. In spite of their being unmolested, they were shy, and used to hide amongst the dense foliage of the tree-tops, seldom descending into the bushes,



GOLDEN ORIOLE.

and were usually observed flying from one grove to another. I noticed that the flight was rolling and heavy, but swift; and they appeared to avoid taking long flights. I have since then seen the Golden Oriole in many countries, and have always found it a shy bird, difficult to observe or to approach. During the pairing season they may be observed chasing each other from grove to grove; and at that season especially it is a quarrelsome bird, not only as regards its own species, but it will chase away other birds that approach its chosen haunts. For any one who can closely imitate its note, it is no difficult matter to approach within a short distance of it, or rather, to entice it within range. Amongst the German foresters I have found many who can immediately entice an Oriole; but the bird has so good an ear that, although it will at first answer the call, it soon discovers the trick played on it, should a single note be false, and it is then hopeless to try and approach it. I can call this species tolerably well; but an old Oriole will generally find me out before he gets within range. Mr. Carl Sachse, however, is an adept at calling an Oriole; and I have been with him when he has enticed one within a few yards of the place where we were concealed. On one occasion he got three Orioles within range at the same time, which, considering the general wariness of this bird, is a tolerably good proof of his powers of mimicry. The note of the Oriole is a clear loud whistle, varied somewhat so as to resemble the syllables *huidleo, huitidleo, huidleo,* so clearly is the tone given. From its note many

of its local names, such as *Vogel Bülow*, *Schu'z von Bülow* in Germany, and *Kuhankeittäjä*, as it is usually called by the Finnish peasants, are derived. Besides its clear whistle, it has a peculiar harsh mewing call-note; and its note of alarm is a harsh *chirr*. During the pairing season it utters what is apparently a note of affection, resembling the syllable *hio*, by mimicking which, together with its whistle, it can generally be enticed within range. Mr. Carl Sachse sends me the following note on its habits, as observed by him in Rhenish Prussia, viz:—'With us it inhabits the groves where there are small ravines through which water flows, especially beech and oak groves, and where the undergrowth is dense. It arrives at rather irregular times, according to the season. It arrived earliest in 1863 and 1865, in both of which years it was seen as early as the 18th of April; whereas in 1875 the first was seen on the 5th of May. About the middle of August, or from then to the early part of September, it leaves us again; and, as may be almost taken for granted, it raises only one brood in the season. It is a wild, restless, quarrelsome bird; in the pairing season bitter encounters take place, and I have seen four or five together fighting in the air. Long before sunrise its clear flute-like note may be heard; but during the daytime it whistles less frequently. It ranges over a considerable tract; and hence its nest is hard to find, except when it breeds in the gardens. It may be enticed, by imitating its note, to within a few yards' distance, but is hard to shoot, for it hops from twig to twig in the dense foliage, uttering its song in a low tone. Usually a male and a female arrive together; sometimes, however, three or four individuals; and then they immediately commence quarrelling.' The food of the present species is varied according to the season of the year, but it is chiefly insectivorous when insect food is to be had, and more especially so in the spring, before any fruit is ripe. It devours all sorts of insects that inhabit the woodlands, but is especially fond of the large green caterpillars which are found on the leaves of the trees. It also feeds largely on berries and fruit when in season, but is not more destructive in a garden than many other birds, and amply repays any mischief it may do by the number of noxious insects it kills. It is most partial to cherries of all garden fruits, but will also feed on currants, and especially on mulberries. Mr. Sachse informs me that it often does much damage amongst the cherries; and when it has once or twice visited a cherry-tree, and finds the fruit to its liking, it may be shot, whilst feeding there, without much difficulty."

The Golden Oriole is about nine inches in length, and is of a rich golden yellow colour, with black wings and tail; the primary coverts and the secondaries tipped with yellow, while all the tail-feathers have a broad yellow ending, which increases in extent on the outer feathers; between the nostril and the eye is a black spot, the bill is dull reddish, the feet leaden grey, and the iris blood red. The female when quite adult is like the male, but not quite so brilliantly yellow, the black being slightly shaded with greenish; the young birds are whitish beneath, with dusky streaks.

THE FOURTH FAMILY OF THRUSH-LIKE PERCHING BIRDS.

THE DRONGOS (*Dicruridæ*).*

Although showing in some of their characters a certain affinity with the Orioles, the King Crows, or Drongos, as they are also called, are not far removed from the Flycatchers (*Muscicapidæ*), which they resemble, especially in having the nostrils entirely hidden by bristles. They differ, however, from all the Shrikes and Flycatchers in having only ten tail-feathers; and perhaps no better definition of the family could be found than that given by the Marquis of Tweeddale.† "The Dicruridæ," he says, "constitute a natural, self-contained, sharply-defined family, which has its members ranging throughout the Æthiopian and Indian regions and the Austro-Papuan, including the Moluccas. One, and only one, appears to be migratory, *Buchanga leucogenys*, which reaches Japan in the summer months. As indicated by the form of the beak, the presence of strong rictal bristles, the short tarsus, short toes, and anchylosed first phalanges of the outer and middle toes, the *Dicruri* are Muscicapine in their affinities; and this relationship is unmistakably exhibited in their habits. All the species of which the ways have been recorded have the habit of descending from their perches to catch insects on the wing, and then immediately returning to the same or some adjoining place of rest. Some species—such as members of the genera *Bhringa*, *Chaptia*, *Dissemurus*, and several of the genus

* διχρωος, forked; οὐρά, a tail. † Ibis, 1878, p. 69.

Buchanga—never descend to the ground, but capture their prey entirely on the wing. *Edolius forficatus*, according to Pollen ('Faune de Madagascar'), has similar habits. Those species that do descend to the ground, such as *Buchanga atra*, do so to seize their food, and remain only for a short time. This last-named species has the useful habit, where there are extensive plains of long dry grasses without suitable trees or bushes, of sitting on the backs of antelopes, sheep, cattle, &c., using them as beaters, and catching on the wing the insects disturbed by the feet of the grazing animals. The feet in all the *Dicruri* are essentially constructed for grasping, by which, together with the lengthened tail, walking is rendered difficult, if not altogether impossible. During a seven years' residence in India, I never once observed the common King Crow (*Buchanga atra*) move along the ground; and it is the most widely-spread and least specialised of all the Asiatic species. The flight of all is short, but rapid while it lasts."

PIED GRALLINA.

THE FIFTH FAMILY OF THRUSH-LIKE PERCHING BIRDS.
THE WOOD SHRIKES (*Prionopidæ*).

These form a small group of birds whose affinities are not very easy to determine. In many cases the appearance and habits of the species are very much like those of the Flycatchers, but they all possess the chin-angle, reaching in front of the nostrils, to which allusion has already been made.* The members of this family are of somewhat varied form, and are found in Africa, India, Indo-Malayan regions, and Australia. One of the most remarkable of the Wood Shrikes is the Pied Grallina (*Grallina picata*) of Australia, which Mr. Gould places between the Crow Shrikes (*Cracticus*)† and the Cuckoo Shrikes (*Graucalus*); it is known by the names of Magpie Lark and Little Magpie to the Australian colonists, and is described by Mr. Gould in the following manner:—

"Few of the Australian birds are more attractive or more elegant and graceful in their actions, and these, combined with its tame and familiar disposition, must ever obtain for it the friendship and protection of the settlers, whose verandahs and housetops it constantly visits, running along the latter like the Pied Wagtail of our own England. Gilbert states that in Western Australia he observed it congregated in large families on the banks and muddy flats of the lakes around Perth, while in the interior he met with it only in pairs, or at most in small groups of not more than four or five together. He further observes that at Port Essington, on the north coast, it would seem to be only an occasional visitant, for on his arrival there in

* See *ante* p. 2.

† κρακτικος, noisy.

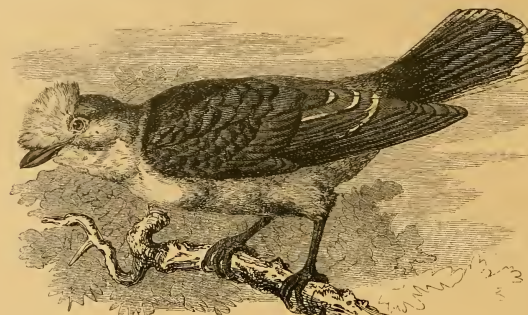
July it was tolerably abundant round the lakes and swamps, but from the setting in of the rainy season in November to his leaving that part of the country in the following March, not an individual was to be seen; it is evident, therefore, that the bird removes from one locality to another according to the season and the more or less abundance of its peculiar food. I believe it feeds solely upon insects and their larvæ, particularly Grasshoppers and Coleoptera. The flight of the Pied Grallina is very peculiar, unlike that of any other Australian bird that came under my notice, and is performed in a straight line, with a heavy flapping motion of the wings. Its natural note is a peculiarly shrill whining whistle, often repeated. It breeds in October and November. The nest is from five to six inches in breadth and three in depth, and is formed of soft mud, which, soon becoming hard and solid upon exposure to the atmosphere, has precisely the appearance of a massive clay-coloured earthenware vessel; and, as if to attract notice, this singular structure is generally placed on some bare horizontal branch, often on the one most exposed to view, sometimes overhanging water and at others in the open forest. The colour of the nest varies with that of the material of which it is formed. Sometimes the clay or mud is sufficiently tenacious to be used without any other material. In those situations where no mud or clay is to be obtained it is constructed of black or brown mould; but the bird, appearing to be aware that this substance will not hold together for want of the adhesive quality of the clay, mixes with it a great quantity of dried grass, stalks, &c., and thus forms a firm and hard exterior, the inside of which is slightly lined with dried grass and a few feathers. The eggs differ considerably in colour and shape, some being extremely lengthened, while others bear a relative proportion. The ground colour of some is a beautiful pearl white, of others a very pale buff; their markings also differ considerably in form and disposition, being in some instances wholly confined to the larger end, in others distributed over the whole of the surface, but always inclined to form a zone at the larger end. In some these markings are of a deep chestnut red, in others light red, intermingled with large clouded spots of grey, appearing as if beneath the surface of the shell. The eggs are generally four, but sometimes only two in number; their average length is one inch and three lines, and their breadth nine lines."

One of the best known forms belonging to this family is the genus *Tephrodornis*,* which contains some half-a-dozen species, inhabitants of India and the Indo-Chinese countries, ranging down the Malayan Peninsula to the Sunda Islands. According to Dr. Jerdon, they go about in small flocks, which frequent thin jungle-groves, gardens, and even hedgerows, generally ranging from tree to tree, and most carefully hunting the branches for insects, chiefly *Coleoptera* and *Orthoptera*. The Common Wood Shrike (*T. pondicerianus*) has a mellow whistling note, and is said to be occasionally caged for its song. In Australia the Wood Shrikes are strongly represented by the genus *Collyricincla*, of which Mr. Gould writes that "they are neither Shrikes nor Thrushes, but most nearly allied to the former, feeding on insects to a very great extent, but occasionally partaking of molluscs and berries. Some of them defend themselves vigorously when attacked. The nest is rather slightly built, cup-shaped in form, and is mostly placed in the hollow spout of a tree; the eggs are four in number." In Africa there are also several kinds of Wood Shrikes, the most peculiar being the Helmeted Wood Shrikes (*Prionops*).† Of *P. talacoma*, which is known as Smith's Helmet Shrike, Mr. C. J. Andersson gives the following note, in his "Birds of Damara Land":—"It is always seen in flocks of from half-a-dozen to a dozen individuals, which frequent secluded spots, where they restlessly hop from branch to branch on the bushes and the lower boughs of the trees, never remaining long on the same tree, but hunting most systematically for insects, which, with the occasional addition of young shoots and leaves, form their food. Whilst some individuals of the flock are examining a tree in search of insects, others keep moving slowly on, but rarely going farther than the next tree. When the locality is open, those which first reach a tree fix their gaze intently on the ground, and if any prey be in sight, pounce upon it with great celerity, their companions, whilst the successful preyers are devouring their booty, continuing to move on slowly as before." Of Retzius' Helmet Shrike, which is also found in Damara Land, the same observer remarks:—"When encamped in the desert, a few days' journey south of the Okavango, I for the first and only time observed this fine Shrike. The flock consisted of six individuals—an adult male and female, and four young birds of both sexes—all of which I secured after much running and dodging, as they were

* τεφρώδης, ash-coloured; ὄρνις, a bird.

† πρίων, a saw; ὤψ, a face.

exceedingly wary and watchful, always perching on the loftiest and most exposed trees: in which respect they differed from the preceding species, though they resembled it in the manner in which they were feeding when I first saw them."



HELMET SHRIKE.

GROUP II.—CICHLOMORPHÆ, THRUSH-LIKE PASSERES.

THE SIXTH FAMILY OF THRUSH-LIKE PERCHING BIRDS.

THE CUCKOO SHRIKES (*Campophagidæ*).*

These birds are also known by the name of Caterpillar-catchers and Minivets, and are entirely peculiar to the Old World, but do not occur in the Palæarctic region: that is to say, they are absent from Europe and Northern Asia; one species only, the Grey Minivet (*Pericrocotus*† *cinereus*), extending its range into the country of the Amoor in the eastern part of this region. In appearance these birds have much in common with the Shrikes, or rather, with the Wood Shrikes of the preceding pages; the bill, however, is always rather depressed or flattened, showing an approach to the true Flycatchers, but they are easily recognisable by the stiffened shafts of the rump-feathers, which gives this part a prickly feeling when the thumb is gently pressed directly on to the feathers of the lower back and rump. Very little has been recorded of the habits of the African or Indian species; but Mr. Gould has given a very interesting account of the Australian Cuckoo Shrikes. This continent, and the neighbouring islands of the Malay Archipelago, possess a large number of species; and of one of the largest, the Black-faced Cuckoo Shrike (*Graucalus melanops*), Mr. Gould writes as follows:—"It is a very common bird in New South Wales, but is far less numerous in winter than in summer, when it is so generally dispersed over the colony that to particularise situations in which it may be found is quite unnecessary: hills of moderate elevation, flats, and plains thinly covered with large trees, being alike resorted to; but I do not recollect meeting with it in the midst of the thick bushes—situations which, probably, are uncongenial to its habits and mode of life. It is very abundantly dispersed over the plains of the interior, such as the Liverpool and those which stretch away to the northward and eastward of New South Wales. Its flight is undulating and powerful, but is seldom exerted for any other purpose than that of conveying it from one part of the forest to another, or to sally forth in pursuit of an insect which may pass within range of its vision while perched upon some dead branch of a high tree, a habit common to this bird and other members of the genus. On such an elevated perch it sometimes remains for hours together, but during the heat of the day seeks shelter from the rays of the sun by shrouding itself amidst the dense foliage of

* κάμπη, a caterpillar; φαγεῖν, to eat.

† περί, round about; κροκωτός, saffron-coloured.

the trees. Its food consists of insects and their larvæ and berries, but the former appear to be preferred, all kinds being acceptable, from the large Mantis to others of a minute size. It breeds in October and the three following months. The nest is often of a triangular form, in consequence of its being made to fit the angle of the fork of the horizontal branch in which it is placed. It is entirely composed of small dead twigs, firmly matted together with a very fine, white, downy substance, like cobwebs, and a species of *lichen*, giving the nest the same appearance as the branch upon which it is placed, and rendering it most difficult of detection. In some instances I have found the nest ornamented with the broad, white, mouse-eared lichen. It is extremely shallow in form, its depth and breadth depending entirely upon that of the fork in which it is built; the largest I have seen did not exceed six inches in diameter. Its note, which is seldom uttered, is a peculiar single purring or jarring sound, repeated several times in succession."

In Africa the Grey Cuckoo Shrikes, such as that which has been described by Mr. Gould above, are only represented by two species, but the last-named continent possesses some peculiar metallic-plumaged birds, known as the Metallic Cuckoo Shrikes (*Campophaga*). These are replaced in the Himalayas and throughout the Indo-Malayan region by some duller-coloured species, whose prevailing tints are iron-grey. Of the common Indian species (*C. lugubris*) Dr. Jerdon writes:—"It is seen solitary or in small parties, frequenting high trees, the foliage of which it diligently searches for various insects. I have found caterpillars chiefly, also other soft insects, as well as bugs and beetles, but never berries, which Hodgson says it frequently eats. He also asserts that it freely descends to the ground to eat, which I certainly have never witnessed. It is a silent bird in general, but Hutton says it has a plaintive note, which it repeatedly utters while searching through a tree for insects. The same naturalist found its nest in the fork of a tree high up; it was small, shallow, made of grey lichens, roots, &c., and plastered over with cobwebs. The eggs were two, dull grey-green, with close streaks of a dusky brown." The Minivets belonging to the genus *Pericrocotus* are, with the exception of the Grey Minivet alluded to above, distributed over India, the Indo-Chinese countries, and the Malayan region. They are very different in appearance from the sober-plumaged Cuckoo Shrikes, the prevailing colours being black and scarlet, the latter being of such a dazzling hue as to render it painful to the eyes to examine them for long. The habits of these birds resemble those of the *Campophagæ*.

THE SEVENTH FAMILY OF THRUSH-LIKE PERCHING BIRDS.

THE FLYCATCHERS (*Muscicapidæ*).

Any student following the descriptions of the last few families of birds with specimens in his hand would not have failed to notice that the bills were becoming more and more flattened, and that bristles were becoming a more marked feature of the basal portion of the bill. This latter character is the one by which a Flycatcher is generally recognised. The Scansorial Barbets, or *Capitonidæ*, were very remarkable in this respect, but can be distinguished from Flycatchers in an instant by their zygodactyle foot. The Flycatchers are a very numerous family, comprising nearly three hundred species, all of very varied aspect but of very similar habits. Some of them resemble Shrikes; others, again, might be mistaken for Warblers; but a genuine Flycatcher is always to be told by the character of his bill mentioned above.

THE COMMON FLYCATCHER (*Muscicapa grisola*).*

About the time when the Cuckoo visits England a little brown bird also makes his appearance, coming, like the Cuckoo, from Africa, and departing again in the autumn, after having reared his young ones. This is the Common Flycatcher, who must be a familiar object to every dweller in the country, as he sits on the bare branch of a tree or on the rail of an iron fence, uttering his monotonous chirp, and flying without cessation after the passing insects, which he captures with unerring dexterity, and then again resumes his post of observation. As the Flycatcher feeds solely upon insect prey, it is a very useful little bird, and escapes the censure which is hurled at some of its less inoffensive relations; it is stated occasionally to feed on berries. It would appear to eject pellets formed of the hard portions of the insects it devours; and Mr. Bartlett, the Superintendent of the Zoological

* *Musca*, a fly; *capio*, I catch; *griscus*, grey.

Gardens in the Regent's Park, where the Common Flycatcher sometimes takes up its abode in summer, informed the writer that on one occasion he found the ground strewn with little blue pellets, which, on being examined, turned out to be the hard shells of the bodies of bluebottle flies, which had formed a large portion of the food of these birds. The nest is generally placed against a wall, or the trellis-work on a verandah, or on the side of a house, the last being a very favourite situation. The birds are very tame in their nature, and the female will often sit close while the nest is being inspected. When the young have flown, both parents labour to supply them with food; and the nestlings may often be seen perched in a row, and taking food in turn from the old ones. As they get older they will follow their parents about the trees; and it is at this time of year particularly that the Flycatchers somewhat abandon their habit of catching insects on the wing, and search for their food under the leaves of the trees. The Common Flycatcher is about five inches and a half in length; the wing three inches and a quarter; the general colour is dark brown, with lighter brown marks in the middle of each feather; the forehead hoary; the wings and tail darker brown, with pale margins to the secondaries and wing-coverts; the under surface of the body is white, with streaks of brown on the throat, breast, and flanks; the upper breast being washed with light brown, the flanks tinged with yellowish-brown, and the under wing-coverts and axillaries pale fawn colour.

Other species of true Flycatcher, very similar to the English bird, are found in Africa and in Eastern Asia; and like *M. grisola*, the Chinese Flycatcher is migratory, proceeding in winter to the Philippine Islands, and even to some of the Moluccas.

THE FANTAILS (*Rhipidura*).*

All the Fantails are remarkable for a very broad and wide-spreading tail, which spreads out like a fan when the bird is in motion. Commencing in India, the range of the genus extends through the Indo-Chinese countries, all over the Malayan Peninsula and the Malayan Archipelago, to Australia, and even to Oceania. The number of species is very large, and it is especially represented in the Malay Archipelago, where every little island or group of islands possesses a peculiar species. Mr. Gould gives an account† of the White-shafted Fantail (*Rhipidura albiscapa*) in Australia:—"In Tasmania I have seen the White-shafted Fantail, in the depth of winter, in the gullies on the sunny sides of Mount Wellington; and it is my opinion that it only retires at this season to such localities as are sheltered from the bleak south-westerly winds which then so generally prevail, and where insects are still to be found. The bird is also subject to the same law on the continent of Australia; but as the temperature of that country is more equable its effects are not so decided. And in support of this opinion, I may adduce the remark of Caley, who says: 'This species is very common about Paramatta, and I do not recollect having missed it at any period of the year.' It is generally found in pairs, but I have occasionally seen as many as four or five together. It inhabits alike the topmost branches of the highest trees, those of a more moderate growth, and the shrouded and gloomy foliaged dells in the neighbourhood of rivulets. From those retreats it darts out a short distance to capture insects, and in most instances returns to the same branch it had left. While in the air it often assumes a number of lively and beautiful positions, at one moment mounting almost perpendicularly, constantly spreading out its tail to the full extent, and frequently tumbling completely over in the descent; at another it may be seen flitting through the branches, and seeking for insects among the flowers and leaves, repeatedly uttering a sweet twittering song. This Fantail is rather a late breeder, scarcely ever commencing before October, during which and the three following months it rears two and often three broods. Its elegant little nest, closely resembling a wineglass in shape, is woven together with exquisite skill, and is generally composed of the inner bark of a species of *Eucalyptus*, neatly lined with the down of the tree-fern intermingled with flowering stalks of moss, and outwardly matted together with the webs of spiders, which not only serve to envelop the nest, but are also employed to strengthen its attachment to the branch on which it is constructed. The situation of the nest is much varied. I have observed it in the midst of dense brushes, in the more open forest, and placed on a branch overhanging a mountain rivulet, but at all times within a few feet of the ground. In its disposition this little bird is one of the tamest imaginable, allowing of a near approach without evincing the slightest timidity, and will even enter the houses of persons resident in the bush in pursuit of

* ῥιπίς, a fan; οὐρά, a tail.

† "Handbook to the Birds of Australia," Vol. I., p 238.

PARADISE FLYCATCHERS.

gnats and other insects. During the breeding season, however, it exhibits extreme anxiety at the sight of an intruder in the vicinity of its nest." Of the Black Fantail, or Wagtail Flycatcher of the colonists, the same author writes:—"With the exception of Tasmania, this bird has been found in every part of South Australia yet visited by Europeans. At the same time that it is one of the most widely diffused, it is also one of the most tame and familiar of the Australian birds, and consequently a general favourite. It is constantly about the houses, gardens, and stock-yards of the settlers, often running along the banks and close to the noses of the cattle, in order to secure the insects which are roused and attracted by the heat from their nostrils, along the roofs of the buildings, the tops of palings, gates, &c., constructing its pretty nest beneath the verandah, and even entering the rooms to capture its insect prey. It passes much of its time on the ground, over which it runs and darts with the utmost celerity; and when skirting the stream, with tail erect and shaking from side to side, it presents an appearance very similar to that of the Pied Wagtails. The movements of the tails of the two birds, however, are very different, that of the European being perpendicular, while that of the Australian is a kind of lateral swing. Its song, which consists of a few loud and shrill notes, is continually poured forth throughout the entire night, especially if it be moonlight. Its flight is at times gracefully undulating, at others it consists of a series of sudden zigzag starts, but is always of very short duration. It never poises itself in the air, like the *Sisura inquieta*, and never mounts higher than the tops of the trees."

THE PARADISE FLYCATCHERS (*Terpsiphone*).

Like the Fantails, these Flycatchers have a very flat bill, which is bowed outwards, and then curves in towards the tip; and in these two genera and a few allied ones are witnessed the most exaggerated forms of a Flycatcher's bill. The Paradise Flycatchers have beautiful long tails, and the plumage in the adult males is generally pure white, while that of the females is chestnut. It takes some considerable time before the full white plumage is attained, and thus specimens in half plumage are extremely common in collections, as the males commence their life with a red plumage, like the female, and only gradually gain the white plumage of the adult. Dr. Jerdon describes the habits of the Indian Paradise Flycatcher (*Terpsiphone* paradisi*) as follows:—"In its habits it is restless and wandering, flitting continually from branch to branch and from tree to tree. It feeds chiefly on small flies and *Cicadellæ*, almost always capturing them on the wing, sometimes picking one off a leaf or bough. I never saw it descend to the ground, as mentioned by Sykes. It is usually single or in pairs. Its flight is somewhat undulating, and it has a curious appearance on the wing, its long tail moving in jerks. I have heard no note, except a rather loud, harsh, grating cry of alarm. I have never seen its nest. Layard says that it makes a neat nest of moss and lichens, lined with hair and wool. The Ceylon names of the bird are Fire-thief and Cotton-thief respectively for the red and white birds. I have kept this Flycatcher alive for a few days in a closed room, and it used to be flitting about, catching flies and mosquitoes, the whole day. One flew on board a ship in which I was a passenger in the Bay of Bengal, between Madras and Vizagapatam, in October, 1836, and remained three or four days in the rigging. Blyth tells me that he has kept it for many months in a large aviary, where it subsisted on the flies which were attracted by the odour of the shrimps with which various small waders and others were daily supplied."

THE RESTLESS FLYCATCHER (*Sisura*† *inquieta*).

It is a curious fact that, although the Flycatchers are such a large family, the accounts of their habits are singularly monotonous, and present very little difference in this respect. The only person who has minutely noted the various characteristics of the different forms is Mr. Gould, and it is perhaps on account of the greater diversity of form which is met with in Australia. This fact must be the apology for the frequent quotations which are made in the course of this work from his "Handbook to the Birds of Australia." Before quitting the family it seems well to give the habits of the Restless Flycatcher, a very peculiar little bird, as detailed by the celebrated naturalist mentioned above. He writes:—"This species ranges over the whole of the southern portions of the Australian continent, and appears to be as numerous at Swan River as it is in New South Wales, where it may be said to be universally distributed, for I observed it in every part I visited, both

* τέρψις, joy; φωνή, song. † σείω, I shake; οὐρά, a tail.

among the brushes as well as in the more open portions of the country, in all of which it is apparently a stationary species. It is a bird possessing many peculiar and singular habits. It not only captures its prey after the usual manner of the other Flycatchers, but it frequently sallies forth into the open glades of the forest and the cleared lands, and procures it by poising itself in the air with a remarkably quick motion of the wings, precisely after the manner of the English Kestrel (*Tinnunculus alaudarius*), every now and then making sudden perpendicular descents to the ground to capture any insect that may attract its notice. It is while performing these singular movements that it produces the remarkable sound which has procured for it from the colonists of New South Wales the appellation of 'The Grinder.' The singular habits of this species appear to have attracted the notice of all who have paid any attention to the natural history of New South Wales. Mr. Caley observes :—'It is very curious in its actions. In alighting on the stump of a tree it makes several semicircular motions, spreading out its tail at the time, and making a loud noise, something like that caused by a razor grinder at work. I have seen it frequently alight on the ridge of my house, and perform the same evolutions.' To this I may add the following account of the actions and manners of this species, as observed by Gilbert in Western Australia :—'This bird is found in pairs in every variety of situation. Its general note is a loud, harsh cry, several times repeated It also utters a loud clear whistle; but its most singular note is that from which it has obtained its colonial name, and which is only emitted while the bird is in a hovering position at a few feet from the ground. This noise so exactly resembles a grinder at work, that a person unaware of its being produced by a bird might easily be misled. Its mode of flight is one of the most graceful and easy imaginable. It rarely mounts high in flying from tree to tree, but moves horizontally, with its tail but little spread, and with a very slight motion of the wings. It is during this kind of flight that it utters the harsh note above mentioned, the grinding note being only emitted during the graceful hovering motion, the object of which appears to be to attract the notice of the insects beneath, for it invariably terminates in the bird descending to the ground, picking up something, flying into a tree close by, and uttering its shrill and distinct whistle.'"

CHAPTER III.

THE TRUE THRUSHES—THE WARBLERS—THE BABBLING THRUSHES—THE WRENS—THE BULBULS—THE BABBLERS—THE GRASS WARBLERS—THE AMERICAN BABBLERS—THE BUTCHER BIRDS—THE GREENLETS—THE TITMICE.

THE THRUSHES—Arrangement—First Sub-family—THE THRUSHES PROPER—Plumage of Young—Moulting of Adults—THE TRUE THRUSHES—Distribution—THE SONG THRUSH—Migration—How the Heligolanders Catch them—Plans of Capture in Italy—Macgillivray's Description of the Bird in the Hebrides—Its Wonderful Song—Its Distribution—Flight—Food—Pairing—Nest—Plumage—THE BLACKBIRD—Macgillivray's Account of its Habits, Food, Flight, Pairing, and Song—Mr. Weir's Conjecture as to the Language of Birds' Song—Plumage—THE WARBLERS—Plumage of Young and Adult—THE COMMON NIGHTINGALE—Mr. Dresser's Account of the Species—Disposition—Song—Food—Habits—THE BABBLING THRUSHES—Characters—THE WRENS—THE COMMON WREN—Professor Newton's Description of the Hunting of the Wren—The Wren's Nest, as Described by Mr. Macgillivray—Colour and Size of Bird—THE BULBULS—Characters—Where Found—Dr. Jerdon on the Madras Bulbul—Captain Legge's Account of the Habits of the Species—THE TRUE BABBLERS—THE BUSH BABBLERS—Canon Tristram's Description of their Habits—THE BOWER BIRDS—THE REGENT BIRD—Mr. Gould on its Habits—Its "Bower" described—THE GRASS WARBLERS—THE COMMON FANTAIL WARBLER—Its Nest—How it is Constructed—Captain Legge's and Mr. Hume's Notes on the Subject—Habits of the African Species—Colour and Size of the Bird—THE TAILOR BIRD—Distribution—Call—Nest—THE AMERICAN BABBLERS—THE THRASHERS—Characters—The Brown Thrasher—Habits—Song—Disposition—Nest—THE MOCKING BIRDS—Audubon's Account of the Bird—His Love-Song—His Devotion to his Mate—The Young Birds—Nest—Eggs—Their Chief Enemies—Flight—Call—THE SHRIKES, OR BUTCHER BIRDS—Distinctive Features—The Great Grey Shrike—"Shrike's Larder"—Pertinacity in the Chase—Harsh Note—Colour and Size—THE GREENLETS—Mr. Gosse on the Jamaican Species—Their Peculiar Call—THE TITMICE—Characters—Sub-families—THE GREAT TITMOUSE, OR OX-EYE—Its Note—Its Nest—Colour and Size—The Long-tailed Titmouse—Their Beautiful Nest—Colour and Size—THE NUTHATCHES—Peculiar Nest—Habits—Size and Colour.

THE EIGHTH FAMILY OF THRUSH-LIKE PERCHING BIRDS.—THE THRUSHES (*Turdidæ*).

ACCORDING to the most recent arrangements, the Thrushes may be divided into two large sections, which in the present work are treated as sub-families, although Mr. Henry Seebohm, who has devoted

a great deal of study to them, believes that two great *families* ought to be recognised, the Thrushes and the Warblers.

THE FIRST SUB-FAMILY OF THE TURDIDÆ.—THE THRUSHES PROPER (*Turdinæ*).

The young in the first plumage are spotted on the upper parts as well as on the under parts. This plumage is completely moulted in the first autumn before migration; so that young in first winter plumage differ very slightly from adults. Adult birds have only one complete moult in the year, in autumn, before migration. The spring plumage is obtained by casting the ends of the feathers. There is no complete moult in the spring, only such feathers being renewed as have been accidentally injured. So far as we have been able to ascertain, these peculiarities are always in this group correlated with a plain tarsus.*

THE THRUSHES (*Turdus*).

Under the genus *Turdus* are comprised not only the Thrushes but the Blackbirds, as no difference can be discovered by which the latter can be separated under the genus *Merula*, though this has been done by many writers. As a rule Thrushes are spotted, and Blackbirds are uniform in coloration, but structurally they exhibit precisely the same form. In Europe, without counting a few Asiatic species which straggle within its eastern confines, we find the same species that are found in England distributed over the greater part of the continent, such as the Song Thrush, the Missel Thrush, the Fieldfare, the Redwing, the Blackbird, and the Ring Ouzel.

THE SONG THRUSH (*Turdus musicus*).

This familiar bird is found in England all the year round, but it is very doubtful if the individuals which inhabit England in the summer remain there during the winter months. It is now some years ago since Professor Newton drew attention to the fact that a migration of the Song Thrushes is a common occurrence during the latter season of the year, and subsequent observations have only tended to confirm the truth of the statement. During the author's stay in Heligoland in the autumn, numbers of Thrushes passed over the island, and were caught in large numbers in the bushes which are erected by the inhabitants for this purpose in their gardens. A large row of sticks and bush is placed by them generally at the end of the little plots of ground, which are either rented from the Crown, or are the property of the Heligolanders themselves. Most of the ground is taken up by potato patches, that vegetable forming the staple food of the islanders during the winter; but a piece of grass is left for the support of the family sheep, whose milk is consumed in the place of cows' milk, there being no cows upon the island. The larger number of the Thrush bushes are found at the eastern end of the rock, close to the town and in the vicinity of the lighthouse, and are generally placed from east to west, as it is in this direction that most of the migrants arrive on the island. A large net is drawn along the back of the bushes, and in the early morning, before it is quite light, the owner visits his bush, and by suddenly clapping his hands startles the tired and sleeping birds, who fly to the opposite side of the bushes and are immediately entangled in the net. Owing to the scarcity of meat, which arrives in Heligoland from Hamburg only, and the supply of which is less certain during winter, the catching of Thrushes is a serious matter for the supply of the islanders' table. In Belgium and other parts of Europe where a large migration of Thrushes takes place, vast quantities are caught during this period. In Italy, according to Count Salvadori, they are much esteemed for the table, and there are many modes of capturing them. In some places there are tracts of wooded ground which every year are arranged with birdlime and nets; and during the season on some mornings hundreds are caught. In the Maremma Toscana, men gain their livelihood by catching Thrushes and Blackbirds in snares, and each man looks after about three thousand snares. In Sardinia also large numbers are caught, boiled, and put into sacks with myrtle leaves, and are sold at high prices in the markets. "The Song Thrush," writes Macgillivray, "is associated in my memory with the Hebrides, where it is perhaps more abundant than in most parts of Britain. There in the calm summer evening, such as for placid beauty far exceeds any that I have elsewhere seen, when the glorious sun is drawing towards the horizon, and shedding a broad glare of ruddy light over the smooth surface of the ocean; when the scattered sheep, accom-

* Seebohm, "Ibis.," 1879, p. 309.

panied by their frolicsome lambkins, are quietly browsing on the hill; when the broad-winged Eagle is seen skimming along the mountain-ridge, as he wends his way towards his eyry on the far promontory; when no sound comes on the ear save, at intervals, the faint murmur of the waves rushing into the caverns and rising against the faces of the cliffs; when the western breeze stealing over the flowery pastures carries with it the perfume of the wild thyme and white clover, the song of the Thrush is poured forth from the summit of some granite block, shaggy with grey lichens, and returns in softer and sweeter modulations from the sides of the heathy mountains. There may be wilder, louder, and more marvellous songs, and the Mocking-bird may be singing the requiem of the Red Indian of the Ohio, or cheering the heart of his ruthless oppressor, the white man of many inventions; but to me it is all-sufficient, for it enters into the soul, melts the heart into tenderness, diffuses a holy calm, and connects the peace of earth with the transcendent happiness of heaven. In other places the song of the Thrush may be lively and cheering; here, in the ocean-girt solitude, it is gentle and soothing. By its magic influence it smoothes the ruffled surface of the sea of human feelings, as it floats over it at intervals with its varied swells and cadences, like the perfumed wavelets of the summer wind. Here on the hill-side lay thee down on this grassy bank, beside the block of gneiss that in some convulsion of primeval times has been hurled unbroken from the fissured crag above. On the slope beneath are small winding plots of corn, with intervals of pasture, and tufts of the yellow iris. The coast is here formed of shelving crags and jutting promontories, there stretches along in a winding beach of white sand, on which the wavelets rush with gentle murmur. Flocks of Mergansers and dusky Cormorants are fishing in the bay; the white Gannets are flying in strings towards the ocean; the Rock Doves glide past on whistling pinions, and the joyous Starlings bound towards their rocky homes. Hark to the cry of the Cornerake, softened by distance, now seeming to come from afar, now louder, as if borne toward you by the breeze. It has ceased, but the Cuckoo calls to his mate from the cairn on the hill. Again all is silent. The streaks in the channel show that the tide is ebbing; a thin white vapour is spread over the distant islands; and beyond them the spirit wings its flight over the broad surface of the ocean, to where the air and the waters blend on the western horizon. But it is recalled by the clear, loud notes of that speckled warbler, that in the softened sunshine pours forth his wild melodies on the gladdened ear. Listen, and think how should you describe the strain so as to impress its characters on the mind of one who never heard it. Perhaps you might say that it consists of a succession of notes, greatly diversified, repeated at short intervals with variations, and protracted for a long time; that it is loud, clear, and mellow, generally sprightly, but at times tender and melting. You might add that two birds at a distance from each other often respond, the one commencing its song when the other has ceased; and that sometimes several may be heard at once, filling a whole glen with their warblings. Listen again, and say what does it resemble?

"Dear, dear, dear,
In the rocky glen;
Far away, far away, far away
The haunts of men.
There shall we dwell in love
With the lark and the dove,
Cuckoo and corn rail;
Feast on the banded snail,
Worm and gilded fly;
Drink of the crystal rill,
Winding adown the hill,
Never to dry.

With glee, with glee, with glee,
Cheer up, cheer up, cheer up; here
Nothing to harm us; then sing merrily,
Sing to the loved one whose nest is near,
Qui, qui, qui, kween, quip,
Tiurru, tiurru, chipiwi,
Too-tee, too-tee, chiu choo,
Chirri, chirri, chooee,
Quiu, qui, qui.

"No more, pray: the Thrush's song is inimitable and indescribable. It is heard at all seasons in fine weather, but especially in spring and summer, particularly in the early morning and about sunset. But it is not in sunshine only that this gentle songster warbles its wild notes; for often in the midst of the thick rain it takes its stand in some sheltered spot, under the cover of a projecting crag or stone, and for hours perhaps amuses itself with repeating its never-tiring modulations. The Song Thrush, which is a resident species, is distributed over all parts of Scotland and England. In summer it prefers the woods and hill-sides, the bushy banks of streams, and sheltered places at some distance from human habitations, although in cultivated districts it often nestles in the orchards, gardens, and

hedges. In winter the individuals which had made the woods and glens their summer residence approach the houses and feed in the gardens and fields, or betake themselves to the rocky shores, where they find subsistence by breaking the whelks and other shell-fish. Although in the cultivated districts it is seldom seen unless among the bushes or hedges, it is capable of flying to a great distance, which it does in gentle curves, with quick flaps, intermitted at intervals, sometimes at a considerable height, but more frequently only so high as to clear the trees. Its flight is always rapid, and it selects its place with quickness, settling instantaneously. When on the ground, and in the attitude of observation, it drops its wings a little, keeps its tail nearly horizontal, and raises its head obliquely. On observing a worm or other object, it leaps briskly towards it, picks it up, or, if it has withdrawn, pecks at the earth until it has seized it. Its general mode of progression on the ground is by leaping.

SONG THRUSH.

When in a listless mood, it droops the tail and wings, draws in its neck, and ruffles its feathers. In this attitude it may often be seen perched on a tree, bush, or stone. Its food is chiefly found on the ground, and consists of snails, earth-worms, larvæ, coleoptera, hips, berries, and seeds of various kinds. *Helix aspersa, hortensis,* and *nemoralis* supply great part of its food in winter. It breaks the shells by raising them in its bill, and knocking them repeatedly against a stone. Large heaps of the shells thus broken may be seen by garden walls, and in pastures on the edges of thickets. In the Hebrides, where it frequents the shores in winter, it treats the *Turbo littoreus* and *Trochus conuloides* in the same manner; and of these shells the fragments may often be found under shelter of some stone or slab, to which the bird flies with its prey. Many years ago, having in the course of my littoral rambles in Harris, frequently heard a sharp sound like that of a small stone struck upon another, I endeavoured to discover its cause, but for a long time in vain, until at length, being one day in search of birds, when the tide was out, I heard the well-known chink, and standing still discovered at a distance, in a recess formed by two flat stones at the upper part of the shore, a bird moving its head and body alternately upwards and downwards, each downward motion being followed by the noise which had hitherto been so mysterious. Running up to the place I found a Thrush, which, flying off, left a whelk newly broken, but with the animal in it, lying amidst a heap of fragments round a smooth stone.

Having some years after mentioned the circumstance to a scientific friend in Edinburgh, I was favoured with an assurance of the utter impracticability of the feat, which indeed is at first mention not very credible, although one may easily satisfy himself that a whelk, thick as it is, is very easily broken by knocking it smartly against a hard body.

"The full song of this species is heard in April, May, and June, although, as I have already said, it may be occasionally heard at any season. In March it pairs, and by the end of that month, or in the beginning of the next, begins to construct its nest, which is placed in a thick bush of any kind, or in a hedge at a small height, or on a rough bank among shrubs or moss. In the unwooded parts of the country it is found under shelter of a projecting stone or crag, in the crevice of a rock, or at the root of a tuft of heath, or among the stunted willows on the rocky bank of a stream. It is composed externally of slender twigs, roots, grass, and moss, and is lined with a thin layer of mud, cow-dung, or rotten wood, neatly laid on, and between which and the eggs no other substance is interposed. The diameter of the cavity is usually about four inches, its depth from two and a half to four. As a good deal of wrangling has taken place on the subject of Thrushes' nests, I may be allowed to be somewhat particular in this matter. Although the structure of the nest does not vary much, the materials are very diversified. In a nest before me, which is very bulky, the exterior is formed of the long tough roots of various plants, a twig of *Rumex crispus* or *latifolius*, another of the rasp, a clipping of box-wood, a piece of pack-thread, numerous tufts of *Poa annua*, and *Stellaria media*, two or three mosses, and some other substances. Within this is a more elaborate structure of fibrous roots, tufts of grasses, straws, and some beech leaves, interwoven, and compacted with some tenacious substance. This inner cup is lined or plastered with a very thin but firm coating of what seems to be horse-dung, on the surface of which are spread numerous chips of straw and slender grasses, but certainly no decayed wood, as some allege to be usually the case. This nest is in diameter three inches and a half, in depth two and a half, its greatest diameter seven inches, and its greatest depth four and a half. This is the nest of a civilised Thrush, it having been found in a hedge in the immediate vicinity of Modern Athens.

"On the 5th of May, 1836, I found in a honeysuckle bush in a wood between Haddington and Gifford the nest of a Thrush, in which the bird was working at the time, completing its interior, in which was a piece of wet rotten wood, quite soft and friable, which it was applying to the walls. Another nest found near Gifford was plastered with horse-dung. One brought to me from Melville Woods, on the 3rd of May, 1837, by my son, who found in it five eggs, is composed externally of twigs, straws, and stems of herbaceous plants; its inner cup of a few slender twigs of trees, stems, and leaves of grasses, oak leaves, and a large proportion of mosses, interwoven and agglutinated, but without mud. The lining, which is not thicker than two-twelfths of an inch at most, is certainly composed entirely of fragments of rotten wood and other vegetable substances, without any mud, clay, or dung. Its internal diameter at the mouth is three inches and a half, but below the mouth four inches, the depth two and a half. In all the specimens which I have examined, the mouth of the inner cup is contracted and firmly woven. The eggs are generally five, but vary from four to six, of a regular or broad oval form, bright bluish-green, with scattered spots of brownish-black, of a roundish form, and more numerous at the larger end. They vary considerably in size, the largest in my collection measuring thirteen-twelfths by nine-and-a-half, the smallest, eleven-and-a-half by eight-and-a-half twelfths. They are deposited in the end of April, sometimes so early as the beginning of that month, and sometimes not until May. The young I have found abroad from the 20th of April to the middle of June. Another brood is generally reared in the season."

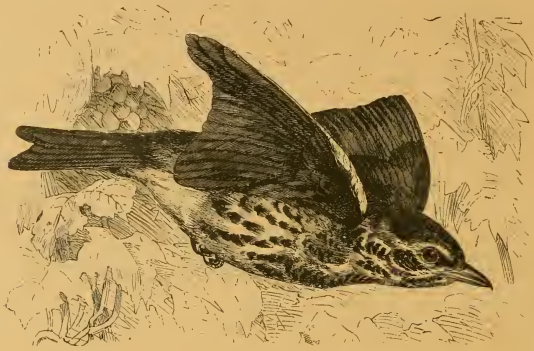
The Thrush is so well-known a bird that it hardly merits a separate description. The general colour above is olive-brown, the wing-coverts more or less distinctly tipped with spots of ochre; the wings and tail are like the back; the under surface is whitish with a fulvous tinge on the breast and sides; the ear-coverts, cheeks, fore-neck, chest, and flanks are all spotted with black; bill blackish-brown, yellowish at the base of the lower mandible; legs pale flesh colour, iris brown. The female is like the male, but young birds are mottled all over with ochraceous buff streaks on the feathers of the upper surface.

The under wing-coverts in the Common Thrush are of a rich golden colour, and are sufficient to distinguish the species at a glance from the nearly allied Redwing (*Turdus iliacus*), which is a

winter visitant to Britain. Besides these two birds there are the Missel Thrush, a fine large species, which has of late years extended its range considerably in England, and the Fieldfare (*Turdus pilaris*), which arrives in that country with the Redwing in the winter, and leaves again before the summer begins. These four species constitute the regular British Thrushes, but one or two European and American species also have occurred within the limits of the British Islands.

THE BLACKBIRD (*Turdus merula*).

Although it is impossible to find any structural difference between a Thrush and a Blackbird, yet the sombre hue of the latter, which prevails both in the British species and in its allies throughout the world, seems to divide the Blackbirds off as a distinct group of the genus *Turdus*. Besides the species of true Thrushes mentioned above, England is inhabited by the common Blackbird and the Ring Ouzel, the former resident, and the latter entirely migratory. To quote once more from the



REDWING.

delightful work of Macgillivray: "The Blackbird, which is one of the most admired of our native songsters, is a permanent resident, and occurs in almost all parts of England and Scotland, although it prefers the more cultivated districts, and is rarely met with in the centre and more elevated tracts. Being, properly speaking, an inhabitant of bushy places and woods, it does not breed in the northern and more remote Hebrides, nor in districts of the mainland destitute of sylvan vegetation. In winter it frequents the neighbourhood of houses and towns, resorting to woods, hedges, and gardens, and generally keeping in the shelter of trees or bushes. At this season its food consists principally of snails, especially *Helix aspersa* and *H. nemoralis*, the shells of which it breaks by raising them in its bill, and dashing them against a stone or other hard surface. It also occasionally breaks them open by pecking against the spire, in which the shell is much thinner. Like many other birds, however, it has a large range of food. Thus, having opened five individuals, I found in the stomach of one a great quantity of seeds and husks of gramina, including wheat and oats; in that of another, coleopterous insects; in that of a third, coleoptera, and seeds of various kinds; in that of the fourth, mollusca and fragments of shells; in that of a fifth, seeds, mollusca, and a few grains of gravel, earthworms, larvæ, berries, and seeds of various kinds. It is amusing to observe a Blackbird searching for food on the smooth green of a garden, which one may easily do from the window without being noticed. In December, 1832, I watched one in order to note its motions. After looking quietly at a particular spot for some time, it hopped up, began to peck the ground with

great energy, and after some exertion succeeded in dragging out a worm of moderate size, which it immediately threw on the ground. It then pecked at the worm for nearly a minute, and, beginning at one end, separated by a sudden stroke a small portion, which it swallowed. In this manner it proceeded until it had devoured the whole, not swallowing at any time more than a small fragment. It then hopped about, looking now and then attentively at a certain spot, and at length began to dig vehemently for another worm, which it soon procured. This was the first time that I had closely watched a Blackbird while searching for worms; but I have since had repeated opportunities of convincing myself that it always proceeds in the same manner, never swallowing an entire worm unless it happens to be extremely small, and cutting the very large ones into a great number of pieces

BLACKBIRD.

The sides of walls and hedges are favourite places of resort, for there it readily procures worms and snails. In hard weather it often eats the berries of the hawthorn, which it swallows whole, and betakes itself to the corn-yards, where it picks up seed chiefly on the ground. When searching for food, it hops or leaps with great alacrity, keeping its tail a little raised and its wings loose; and when perched on a tree, twig, or wall, it generally elevates its tail, unless disposed to doze, in which case it draws in its neck, ruffles its plumage, tucks up its wings, and allows the tail to droop. When disturbed, it flies off uttering a loud chuckling noise, which, although clear and shrill, reminds you of the chatter of the Magpie; and you may pursue it from one part of a hedge to another, until you obtain it, for it seldom shifts to a great distance. Although thus easily procured, it is yet decidedly shy, and in this respect differs greatly from the Song Thrush, which imagines itself secure at a very short distance. The flight of the Blackbird over an open space is steady, without undulations; but along the hedges is wavering and fitful, and the bird suddenly darts into the place which it selects, and instantly settles. During the breeding season its flight is peculiar, for then the female especially moves through the air as if by starts, performing a single flap, followed by a considerable interval, and

then continuing its course. The Missel Thrush, the Fieldfare, and the Redwing frequently take long flights, and are often seen advancing at the height of several hundred yards; but the Blackbird rarely ventures on a long excursion, but prefers skulking, as it were, among the hedges and trees. Compared with the Song Thrush, it is a very lively bird, and it is amusing to observe one that has just alighted on a twig; and see how gracefully it bends forward, throws up its tail, jerking it at intervals, depresses and at intervals flaps its wings, and then perhaps flits to another branch, where it performs the same motions, or alights on the wall, hops along, suddenly stops, jerks its tail, flaps its wings, and then commences singing.

"Even in severe weather in winter Blackbirds are not gregarious; and on no occasion have I seen more than three or four together, and that only for a few minutes. Although a male and a female may sometimes associate during that season, it is much more common to find them solitary. Nor does this species cherish the society of any other, though it may be seen in the vicinity of a Song Thrush, a Hedge Chanter, or other small bird. While the Fieldfares and Redwings cover a field in search of food, the Blackbirds very seldom venture amongst them, but prefer the shelter of the fences. The female is less clamorous than the male, who, on being alarmed or irritated, especially in the breeding season, emits a loud clear chuckling cry, in some degree approaching to the chatter of the Magpie, fluttering or flapping its wings, and bending its body forward at the same time. This remarkable cry, variously modulated by different individuals, sometimes exhibits a slight resemblance to the cackle of a domestic hen after laying; but whether it be the same as that alluded to by a correspondent in the 'Naturalist,' as similar to the crowing of a cock, and by the editor of that journal as resembling the notes of several varieties of that species, I am unable to determine, not having listened to the individuals mentioned by them. This much, however, I have observed, not as a singular circumstance, nor even as one common to a few individuals, but as exhibited at all seasons, at the period of breeding, and in the middle of winter, and by very many birds of the species, that the male, on perching, whether on a tree or on the ground, but especially on the former, raises his tail, flutters, it might almost be said, flaps his wings, emits his chuckling cry, and continues balancing himself, or hops along, repeating the notes, which, should he be alarmed, or in any way excited, are sometimes raised and prolonged, so that a person fond of tracing affinities and analogies might naturally enough liken it to the crowing of a cock.

"It is not in the wild valley, flanked with birchen slopes, and stretching far away among the craggy hills, that the music of the Blackbird floats upon the evening breeze. There you may listen delighted to the gentle song of the Mavis; but here, in the plain, covered with cornfields, and skirted with gardens, sit thee down on the green turf by the gliding brook, and mark the little black speck stuck, as it were, upon the top twig of that tall poplar. It is a Blackbird, for now the sweet strain, loud, but mellowed by distance, comes upon the ear, inspiring pleasant thoughts, and banishing care and sorrow. The bird has evidently learnt his part by long practice, for he sings sedately and in the full consciousness of superiority. Ceasing at intervals, he renews the strain, varying it so that although you can trace an occasional repetition of notes, the staves are never precisely the same. You may sit an hour, or longer, and yet the song will be continued; and in the neighbouring gardens many rival songsters will sometimes raise their voices at once, or delight you with alternate strains. And now, what is the purpose of all this melody? We can only conjecture that it is the expression of the perfect happiness which the creature is enjoying, when, uncarked by care, conscious of security, and aware of the presence of his mate, he instinctively pours forth his soul in joy and gratitude and love. He does not sing to amuse his mate, as many have supposed, for he often sings in winter when he has not yet mated; nor does he sing to beguile his solitude, for now he is not solitary; but he sings because all his wants are satisfied, his whole frame glowing with health, and because his Maker has gifted him with the power of uttering sweet sounds."

"That some of the notes of birds," writes Mr. Weir, "are a language which conveys a direct meaning, may, I presume, be inferred from the following interesting occurrence, which took place at half-past three o'clock, an occurrence which I witnessed with the most anxious curiosity, and which I could scarcely have believed had I not seen it. The female having brought a large worm, I am sure more than four inches in length, put it into the mouth of one of the young, and then flew away. Upon her return, having perceived that it was sticking in its throat, she set up a moan of distress. To her

assistance her cry immediately brought her partner, who likewise seemed to be aware of the consequences. To force it down they made several efforts, but in this they were unsuccessful. Strange to tell, the male at length discovered the cause of the catastrophe. The part of the worm which by being entangled among the feathers of the breast had been prevented from going down, he carefully disengaged, and held it up with his bill, until, after the most unusual efforts, the young bird at length swallowed it. But so much exhausted was it that it remained for nearly three hours without moving, and with its eyes shut. The male, having alighted upon a tree a few yards from his nest, poured forth some of his most enchanting notes, a song of rejoicing, no doubt, for the narrow escape from death which one of his family had just made."

The Blackbird, as its name implies, is entirely black, with an orange bill, and a ring of orange round the eye. The female is brown, with a dark-brown bill; more or less rufous on the throat and breast, which have black stripes. Varieties are often met with, especially some with white feathers distributed among the black plumage, but these are not to be confounded with the Ring Ouzel (*Turdus torquatus*), which is a summer visitant to England, and is distinguished by the broad white collar on the breast. The latter bird has also a very distinct winter plumage, when the black feathers are broadly edged with greyish-white. It should be added that very old Blackbirds have the feathers of the hind neck tipped with fine hairs.

Besides the true Thrushes, the sub-family Turdinæ includes the Chats, represented in England by the Wheatear, and the Redstarts.

THE SECOND SUB-FAMILY OF THE TURDIDÆ, OR THRUSHES. THE WARBLERS (*Sylviinæ*).

The young in first plumage are unspotted on the upper parts (except in those cases where the adult birds are so also), and only in rare instances are traces of spots to be found on the breast. The adult birds moult twice in the year, in spring and autumn, both moults being complete. Birds in first plumage, having an opportunity of moulting in spring, do not require to moult in the first autumn, and only renew a few feathers then. Consequently, there is frequently a difference, principally in the colour of the under parts, between the young and the adult in winter plumage. So far as can be ascertained the characters assigned to the Warblers are always associated with a scutellated tarsus.*

THE COMMON NIGHTINGALE (*Daulias luscinia*).

This, the most favourite Warbler of ancient and modern times, is a summer visitor to England, retiring in winter to northern Africa, and even penetrating as far as the Gold Coast, in western Africa. Mr. Dresser gives the following account of the species in his work on the "Birds of Europe":—

"This, the best known and most highly esteemed of our songsters, is essentially a bird of the woodlands, and is always found in the groves or woods on the plains, never in the mountains, or in conifer woods, but in tolerably low, non-evergreen growth, where there is a fairly abundant undergrowth, and where the soil is rather damp, or where damp ditches or water is not far distant. It is a very unobtrusive bird; and although the song of the male may be heard daily, it is astonishing how seldom a casual observer obtains a glimpse of the bird itself. The males arrive first in the spring, and appear to be weary and travel-worn when they first appear; but they soon recuperate, and when, after the lapse of a few days, the females commence to appear, they have recovered their usual sprightliness and soon break out into their matchless song, which may be heard until the young are hatched. The song of this bird is, with justice, considered to be the richest and most melodious of all our songsters; and it is impossible to reproduce its notes in words so as to give any idea of it. No bird has so varied and sweet a song, and it is so rich and full that one is astonished that it can be produced by so small a bird. There is, however, much individual difference in the quality of the song of birds from different localities, as is well known by all the bird fanciers, especially by the Germans; and Naumann remarks that those from Pomerania are the worst songsters, whereas those from Wörlitz in Anhalt Dessau are the best he ever heard. As a rule, the Nightingale is not a shy bird; and far from shunning the presence of man, it appears in preference to take up its abode somewhere in the vicinity of inhabited places. Nor is it a quarrelsome bird towards others of its own species, except during the

* Seebohm.

pairing season, when frequent disputes occur amongst the males. It usually frequents the lower branches of the trees, or the bushes, where it does not move about much, but sits with the wings rather drooped; and when it moves it usually flirts its tail, which when the bird is sitting is held in an almost horizontal position. When on the ground it carries the body erect, and looks very long-legged. It progresses by means of long jumps, and after taking ten or a dozen it usually stands still, pauses for a moment, as if thinking of what is next to be done, and then, with a flirt of the tail, hops on again. Its food, which is chiefly picked up from the ground, consists of worms, insects, and especially of insect larvæ; and it frequently searches for insects in old rotten timber and moss. It is also said to be very fond not only of the larvæ of ants (or so-called ants' eggs) but also of the ants themselves. Naumann says that it is partial to currants, both red and black, when ripe, and is very fond of elder-berries. Insects, however, are its staple food, and its partiality for a meal-worm renders it an easy victim to the bird-catchers. Large numbers are trapped every season, but few survive; for it is certainly one of the most difficult species to keep in confinement. Most of the birds are caught soon after they arrive, and but comparatively few of these are females. According to Harting, in the year 1867 three London bird-catchers, between April 13th and May 2nd, took two hundred and twenty-five Nightingales, all, except some half-a-dozen, cock birds. The previous year, the same men supplied the dealer who employed them with two hundred and eighty Nightingales, of which not more than sixty were hens. When both males and females have arrived from the south they soon commence nidification, and appear to resort to their old breeding localities. At first, not a few conflicts for the possession of their coveted locality take place, but when they have all selected their mates, each pair seems to settle down quietly in a suitable place; and then they live in amity together, though each pair asserts the right of possession in their own small domain. The site for the nest is selected in a garden where the hedges are thick, or in a well-shaded lane, or else in a wood where the underwood is not too dense, and where the grass and low growth are thick in places. The nest is placed either on or close to the ground, in the latter case usually not more than a foot or so high, in a bunch of twigs, in an old tree-trunk, or in a dense hedge or bundle of faggots. The structure is composed, outside, of dry leaves, usually of the oak, inside which are a few dry bents, and sometimes rushes, or even fine flags; and the cup is carefully lined with fine roots and bents, and occasionally a little horsehair is added. The eggs, from four to six in number, are deposited in May, only one brood being raised in the season. They are uniform deep olive-brown in colour, sometimes with a greenish tinge, and occasionally tinged with reddish-brown, on a greenish-blue, or an olive-green surface, which is sometimes entirely, and sometimes only partially, exposed; and not unfrequently the brown is collected at one end of the egg. In size they vary from about $\frac{3}{4}\frac{5}{0}$ by $\frac{2}{4}\frac{7}{0}$ by $\frac{2}{3}\frac{3}{0}$ inch. When the young are hatched the male ceases its song, and appears to devote its time to procure food for its offspring. Should danger threaten, a single loud croak is uttered as an alarm note, occasionally accompanied by a snapping of the bill. Its usual call-note is a clear, somewhat prolonged *wid* or *weed;* and pleasure is expressed by a deep note like *tack*. Its flight is swift and light, but it usually flies only short distances from bush to bush, and during the day-time at least it never seems to fly across any large open space; yet its power of flight must be by no means inconsiderable, as it traverses considerable distances on passage."

Besides the Nightingale, which has been selected as a typical Warbler, all the Whitethroats, and Sedge and Reed Warblers, are included in the sub-family *Sylviinæ*, besides a great number which are not found in the British Isles.

THE NINTH FAMILY OF THRUSH-LIKE PERCHING BIRDS.
THE BABBLING THRUSHES (*Timeliinæ*).

These birds constitute a large family, the exact limits of which it is by no means easy to define, but they possess one character which distinguishes them, and that is their rounded and concave wing, which is so formed as to fit close to the body. On being opened, or rather, parted from the side of the body, the arc described by the wing goes far towards the formation of a letter S; and in order fully to appreciate this characteristic, the wing of a true Thrush requires to be compared with that of a thoroughly typical Babbler. Thus, for instance, the wing of the Common Thrush is long and almost flat, its concavity being scarcely perceptible. A further mark of a true Thrush—with which are to be associated the Warblers and Chats—is the possession of a small bastard primary, the second quill being immensely long in comparison, and approaching the longer ones in dimensions. All these birds which

COMMON NIGHTINGALE.

possess this wing are powerful migrants. The *Timeliidæ*, on the other hand, with their feeble rounded wings, in which the bastard primary of the true Thrush is replaced by a broad first quill, are very poor fliers, and consequently, for the most part, stay-at-home or non-migratory birds. In this large family will be found several diverging elements: thus in some of the true Babbling Thrushes an approach is seen to the *Muscicapidæ*, or Flycatchers, while the Wrens (*Troglodytinæ*) and the Grass Warblers (*Cisticolinæ*) lead the student to the Titmice on the one hand and to the true Warblers on the other. The true Thrushes are approached by the Babbling Thrushes and the Bulbuls.

THE FIRST SUB-FAMILY OF THE TIMELIIDÆ.—THE WRENS (*Troglodytinæ*).

These are nearly all birds of small size, inhabiting the northern and temperate parts of both the Old and New Worlds. They differ from the rest of the Babblers in having scarcely any perceptible notch in the bill, which is rather long and curved; the tail is in general short in proportion to the body. The type of the family is

THE COMMON WREN (*Troglodytes parvulus*).

With the exception of the Gold-crest, this is the smallest English bird: it is generally distributed throughout the whole of Europe, and ranges as far as Central Asia. In England it is a general favourite, and, like the Robin, is accorded a certain amount of protection; and to many readers the old couplet about the "Robin and the Wren being God's cock and hen" will occur. It is difficult, therefore, to account for the persecution to which the species was formerly subjected in certain parts of Great Britain and even in France. Professor Newton* writes:—"The curious custom of 'hunting the Wren' has been mentioned by many writers; but little can be added to the accounts of it given by the late Sir Henry Ellis, in his notes to Brand's 'Popular Antiquities,' and by Thompson, though, from its practice obtaining in countries far apart, it is most likely of much greater antiquity than has been often supposed. It seems to have been first noticed by Charles Smith, in his 'State of the County of Cork,' published in 1750, as followed in the South of Ireland, and subsequently by Vallancy ('Collectanea de Rebus Hibernicis'). On Christmas Day boys and men, each using two sticks—one to beat the bushes, the other to fling at the bird—went out in a body to hunt and kill the Wren, which, from its habit of making but short flights, was no doubt soon done to death. On the following day, the feast of St. Stephen, the dead bird, hung by the leg between two hoops, crossed at right angles and decked with ribbons, was carried about by the 'Wren-boys,' who sang a song beginning, 'Droelin, Droelin, ri an t-eun' (that is, 'Wren, Wren, king of birds'), and begged money 'to bury the Wren.' This ceremony, which, however it may have arisen, had become quite senseless, was, when Thompson wrote, falling into disuse, and in 1845 the then Mayor of Cork, by proclamation, forbade its continuance. Mr. Halliwell ('Nursery Rhymes') notices the same practice in the Isle of Man, and gives the words there sung; while on February 4th, 1846 (as appears by the *Literary Gazette*, p. 131, of the 7th of that month), Mr. Crofton Croker drew attention to the subject at a meeting of the British Archæological Association, and it was stated that a similar custom existed in Pembrokeshire, where on Twelfth Day a Wren was carried from house to house in a box with glass windows surmounted by a wheel, to which ribbons were hung. Sonnini ('Voyage dans la haute et la basse Egypte') mentions a like ceremony practised a century ago, towards the end of December, at La Civtat, near Marseilles, but there the Wren's murderers were armed with swords and pistols, and their victim was slung to a pole borne, as if it were a heavy load, on the shoulders of two men, who paraded the village, and then, after gravely weighing it in a pair of great scales, all gave themselves up to festivity. It is for antiquaries to throw light on the origin of this widely-spread custom, of which many unsatisfactory explanations have been attempted. It has been ascribed to a Wren which, alighting on a drumhead, roused and saved from defeat some Protestant troops in the Irish civil wars of the seventeenth century. Others refer it to a similar incident some centuries earlier, in the wars of the Danish occupation of Ireland. Others say that the Wren was an object of so great veneration to the 'Druids,' that the early Christian missionaries enjoined its persecution upon

* Edition of Yarrell's "British Birds," p. 460.

all adherents to the new faith. Any speculations would here be futile, though one cannot but be struck with some coincidences. The Wren, in the first line of the Irish song, is called the 'king of birds.' The Pembrokeshire ceremony was or is performed on Twelfth Day—the feast of the three kings—and the bird was also spoken of as the king. The common name of the bird, shared to some extent with the Golden-crested Wren, in most European languages—*Basiliskos, Regulus, Regezuels, Reations, Roitelet, Zaunkönig, Kungsfogel, Ellekonge, Winterkoninkje*, and so forth—all assign to it the kingly dignity. These names probably are connected with the old and well-known fable of birds choosing for their king that one of them which should mount highest in the air. This the Eagle seemed to do, and all were ready to do him homage, when a loud burst of song was heard, and perched upon the Eagle's head was the exultant Wren, which, unseen and unfelt, had been borne aloft by the giant. In England this story does not seem to have had hold, and so far from ascribing royal qualities to our little favourite, it is nearly everywhere known to us by the humbler name of 'Kitty' or 'Jenny' Wren."

Considering the size of the Wren, its song is remarkably loud, sweet, and sustained, and it is also favourably regarded by every birds'-nester for its beautiful nest. The latter is placed in various situations, being sometimes built into the thatch of a summer-house, or carefully inserted in some trellis-work overhung by mosses, portions of which are grouped round the opening of the nest, in order the more effectually to conceal it from view. It is also frequently built against the side of a tree, especially if the ivy has been cut through and killed, when the bird will place its nest amidst a mass of brown and decaying leaves, some of which are also employed to conceal the position of its home. The following is a description* of a Wren's nest, as given by Macgillivray:—"One brought me by my son, which he found while gathering plants in a wood near Melville Castle, is of astonishing size compared with that of its architect, its greatest diameter being seven inches, and its height five. It presents the appearance of a rude mass of decayed vegetables, of an irregularly rounded form. Having been placed on a flat surface under a bank, its base is of a corresponding form, and is composed of layers of decayed ferns and other plants, mixed with twigs of herbaceous and woody vegetables. Similar materials have been employed in raising the outer wall of the nest itself, of which the interior is spherical and three inches in diameter. The wall is composed of mosses of several species, quite fresh and green, and it is arched over with fern leaves and straws. The mosses are curiously interwoven with fibrous roots and hair of various animals, and the inner surface is even and compact, like coarse felt. To the height of two inches there is a copious lining of large soft feathers, chiefly of the Wood Pigeon, but also of the Pheasant and Domestic Duck, with a few of the Blackbird. The aperture, which is in front and in the form of a low arch, two inches in breadth at the base, and an inch and a half in height, has its lower edge formed of slender twigs, strong herbaceous stalks, and stems of grasses, the rest being felted in the usual manner. This nest is a magazine of botany, there entering into its composition leaves of *Fagus sylvatica*, fronds of *Aspidium dilatatum* and *A. filix mas*, blades of *Phalaris arundinacea*, stems of several grasses and other herbaceous plants, some twigs of the larch and other trees, and four or five species of *Hypnum*. It contained five eggs, of an elongated oval form, averaging eight lines in length and six lines in breadth, pure white, with some scattered dots of light red at the larger end, one of them with scarcely any, and another with a great number. Of three nests presented to me by Mr. Weir, one is extremely beautiful, being composed entirely of fresh green hypna, without any internal layer, although, no eggs having been found in it, it possibly had not been completed. It is of an oblong form, seven inches in length, and four in its transverse diameter. The mouth measures an inch and eight-twelfths across, one inch and a twelfth in height. Its lower part is formed of small twigs of larch laid across and interwoven, so as to present a firm pediment. The longitudinal diameter of the interior is three inches and a half. Another, formed on a decayed tuft of *Aira cæspitosa*, is globular, six inches in diameter, and composed of moss, with a lining of hair and feathers, chiefly of the domestic fowl. The third is globular, and externally formed almost entirely of ferns like that described above. In all the nests of this species which I have seen the lower part of the mouth was composed of twigs of trees or stems of herbaceous plants, laid across, and kept together with moss and hair. The nests are found in a great variety of situations: very often in a recess overhung by a bank, sometimes in a crevice among stones, in the

* "British Birds," Vol. III., p. 21.

hole of a wall or of a tree, among the thatch of a cottage or outhouse, on the loft of a shed or barn, the branch of a tree, whether growing along a wall or standing free, among ivy, honeysuckle, clematis, or other climbing plants. When the nest is on the ground its base is generally formed of leaves, twigs, and straws, and its interior is often similar; but when otherwise, the outer surface is generally smooth, and chiefly composed of moss. Several authors have spoken of the nests frequently constructed by this bird in spring and afterwards abandoned, and have indulged in various conjectures respecting them. I should suppose that a nest may occasionally be partially or entirely built, and then deserted, because its owners find it unsafe or have been frightened from it. The Magpie often commences a nest and leaves it unfinished, probably for the same reason; and the same remark may be made as to the Blackbird and Thrush. But Mr. Wood relates a very curious fact respecting the Wren, which is that it 'often builds itself a dwelling in autumn, and lodges in it on cold nights. These nests,' he continues, 'are mostly constructed in the usual localities, though I once found one situated in an old

COMMON WREN.

Garden Thrush's nest in a Portugal laurel. Frequently, also, the nests in which one or two broods had been reared in summer are tenanted every night throughout the winter.' On this subject Mr. Weir has sent me the following remarks:—'During the period of incubation, the male (says an anonymous writer in Mr. Loudon's Magazine), apparently from a desire to be doing something, constructs as many as half-a-dozen nests in the vicinity of the first, none of which are lined with feathers; and whilst the first nest is so artfully concealed as to be seldom found, the latter are very frequently seen. With respect to the use of these structures, or cock-nests, as they are called in England, if we believe that birds, like some insects, have foresight, a more ingenious theory might be advanced. During the severity of winter they may be intended as houses of refuge for them and their families.* Whether this be always the case or not it will be difficult to ascertain. That they are, however, sometimes employed for this purpose I can affirm, as the whole of those in my neighbourhood during the late severe frosty weather (of 1837–8) were occupied by them. I have one of these nests in my possession in which they lodged, and in which there was a quantity of their droppings.' The Wren being a very diminutive bird, might be supposed to require this kind of shelter

* The writer was assured by a lad living at Colgate, Sussex, that during the severe winter of 1878–9 he frequently found Wrens roosting in the old nests, and on one occasion he captured five in the same nest.

in winter, were it not that the Kinglets and Tits, equally small, are not known to lodge in their nests. Our little friend is a Troglodyte, a frequenter of holes and caverns, and as it always reposes at night in some sheltered retreat, it may occasionally or often betake itself to its old nest as well as to any other place, as that nest is well fitted for its purpose; but there seems no reason for supposing that this is habitual with all Wrens, many of which, in the wilder parts of the country and in the Hebrides, desert their summer habitations, and in winter reside about the farmyards."

The length of the Common Wren is only three inches and a half, the wing two inches. The colour of the upper parts is rufous-brown, more decidedly rufous on the tail and wings, the upper surface barred across with blackish-brown, the outside wing feathers being barred with dark brown and dull white; over the eye a white line; below the body is dull whitish, slightly washed with rufous on the breast; the abdomen, vent, and under tail-coverts washed with rufous-brown, barred with blackish; bill brown, as well as the eye; legs light brown.

THE SECOND SUB-FAMILY OF THE TIMELIIDÆ.—THE BULBULS (*Brachypodinæ*).

These are a small group of birds which are intermediate between true Babblers and the Thrushes. They are remarkable for their very short legs, which are accompanied by short and very rounded wings. They are entirely inhabitants of the Old World, some genera, such as the Bristle-necked Bulbuls (*Criniger*), being widely distributed in Western Africa, and recurring again in India and the Indo-Malayan countries and islands. The Red-whiskered Bulbul (*Otocompsa jocosa*), an inhabitant of India and the Burmese countries, is said by Dr. Jerdon to be a most lively and active bird, always on the move, warbling its pleasant chirruping notes, which are more agreeable than those of the Common Bengal Bulbul. Its flight is steady but not very rapid, and its crest is always raised the moment it alights. The nest is neatly made, deep, cup-shaped, of moss, lichens, and small roots, lined with hair and down; the eggs are reddish-white with spots of lake, or purplish all over, larger at the thick end. It lives chiefly on fruits and seeds, robbing the gardens of peas, strawberries, &c. Now and then it takes insects, and Dr. Jerdon has seen it come to the ground after them. Writing of the Common Madras Bulbul (*Pycnonotus hæmorrhous*), Dr. Jerdon observes that it "frequents gardens and cultivated ground, and low bushy jungle, but is never found in forests, and it ascends the Neilgherries to about 6,000 feet only. It is usually seen in pairs, or in small families, flying briskly about, restless and inquisitive, feeding chiefly on fruits, but occasionally descending to the ground, and even hopping a step or two and picking up insects. It destroys various buds and blossoms also, and is very destructive to peas, strawberries, brazil cherries (*Physalis peruviania*), and other soft fruit. Its note, which it is frequently uttering, is an unmusical, rather harsh chirrup. It has at times, however, a sweeter note, and it is said to be able to imitate the notes of other birds when caged. Its flight is direct, performed by a continued quick flapping of the wings. It breeds from June to September, according to the locality. The nest is rather neat, cup-shaped, made of roots and grass, lined with hair, fibres, and spiders' webs, placed at no great height in a shrub or hedge. The eggs are pale-pinkish, with spots of darker lake-red, most crowded at the thick end. Burger describes them as rich madder colour, spotted and blotched with grey and madder-brown; Layard, as pale cream, with darker markings. The Bulbul is very commonly caged in various parts of the country, and in the Carnatic it is kept for fighting, being held on the finger with a cord attached. They fight sometimes with great spirit, often," I am assured, seizing their antagonist by the red feathers, and endeavouring to pull them out. When excited they often spread out these feathers laterally, so as to be seen even from above."

The account of the habits of the Bulbuls is so meagre that scarcely anything can be said about them. Perhaps the best notice that has ever appeared is that given by Captain Legge in his work on the "Birds of Ceylon":—

"The Madras Bulbul is a very common bird, and is found in Ceylon abundantly throughout the whole of the island to a general altitude of about 3,500 feet, and in Uva ranges to about 5,900 feet, its highest point being the neighbourhood of Hakgala, to which it extends from the Fort MacDonald patnas, a portion of the Kandyan Province where many low-country birds are located. It is most numerous in open and cultivated districts, particularly in the west and south of the island, and in the maritime portions of the eastern and northern divisions. In the extensive forests of the east and

north-central portions it inhabits chiefly those localities which have been cleared and are now open or covered with low jungle; but in the depths of the woods it is less frequent than the White-eyebrowed Bulbul. In Dumbara and other wide valleys of the Central Province it is almost as common as in the low country, but it does not range so high on the Rambodde side as in Uva. Neither Kelaart nor Mr. Holdsworth records it from Nuwara Eliya, nor have I myself observed it there. That it should not occur even as a straggler or occasional visitant in the gardens of the residents, while it is not unfrequent just lower down the valley at Hakgala, is perhaps a proof that it is not able to withstand the frost and cold at nights on the plain.

"Of this Bulbul Jerdon says that it is one of the most common and generally-spread birds in the south of India, extending throughout the southern part of the peninsula to the Nerbudda river, and beyond it apparently to the north-west. It ascends the Neilgherries to about 6,000 feet, and it is, says Dr. Fairbank, found at the top of the Palanis, though it is more abundant at the bottom and on the adjacent plains; in the Khandala district it is an inhabitant of the slopes of the hills, as well as the neighbouring portion of the Deccan. To the north-west it extends as far as Sindh, to the avifauna of which province Mr. Blanford has recently added it, stating that it is found in the deserts of Umarkot. Captain Butler remarks that it is found all over the hills and plains of Northern Guzerat, to which Mr. Hume adds, 'Common at Sambhur and in the eastern portions of Jodhpoor, also in Cutch and Kattiawar. In Western Jodhpoor it occurs for the most part only in the rains.' In Bengal it is replaced by the large and allied species *P. pygæus*, which extends eastwards into Burmah.

"The Madras Bulbul affects gardens, compounds, cinnamon plantations, the vicinity of roads, low jungle, open scrubby land, and the edges of forest. It is a fearless and very sprightly bird, most active and animated in its manners, erecting its conspicuous crest to full height as it sits on the top of a bush chirping to its companions. It locates itself in close proximity to houses, and not unfrequently builds its nest in verandahs, and is consequently a universal favourite with Europeans, who rate its attempts at singing so highly that it is styled by many the 'Ceylon Nightingale!' As a matter of fact, however, its notes have but little music in them; but it is constantly uttering its quick chirruping warble, which, in the breeding-season, is to a certain extent more melodious than at other times. Its food consists of insects, as well as fruit and seeds of all kinds, the berry of the *Lantana* plant being a favourite diet, a fact which conduces to the propagation and spreading of this horticultural pest. In the evening little parties of this Bulbul assemble, and after a great deal of excitement and chattering they choose a roosting-place in some thick bush or umbrageous shrub.

"Jerdon remarks, in his 'Birds of India,' that in the Carnatic it is kept for fighting, and that it seizes its antagonist by the red feathers, attempting to pull them out. It is said to imitate the notes of other birds when caged. I am not aware that this habit has been much noticed in Ceylon; but it is a great favourite as a caged bird with the natives, becoming excessively tame, and allowing itself to be carried about by hand. . . . . .

"In the western and southern portions of the island this bird breeds, as a rule, between January and May, and on the eastern side during the north-east rains at the end of the year. It appears, however, to have more than one brood in the year, the second being reared as late as August or September. Its nest is a loosely-made cup-shaped structure of fine twigs, grass, and bents, with a scanty lining of grass or vegetable fibre, fixed in the fork of a branch in low bushes a few feet from the ground. It frequently chooses a small lime-tree close to a dwelling, and will sometimes, as above-mentioned, build in the verandahs of houses. In a rest-house on the Trincomalee and Batticola road, I once found a nest placed between the tiles and a rafter over the entrance to the apartment, the pretty little owner taking no notice whatever of the passers-by, and, as we stood admiring her, scanned us from her little habitation with an amount of fearless curiosity that was charming to behold. The eggs are three or four in number, and vary somewhat in shape, the usual form being a pointed oval. The ground is reddish-white, blotched and speckled all over, but most thickly at the large end, where there is often a cap or zone of colour, with reddish-brown of two shades over a few bluish-grey spots, some eggs having much more of the latter tint than others. They measure from 0·84 to 0·87 inch in length by 0·64 to 0·66 in breadth.

"In India the breeding-season lasts in the plains from April until August, but in the Neilgherries

it breeds as early as April. Its nest is much the same as in Ceylon; but the late Mr. A. Anderson speaks of one which was 'entirely composed of green twigs of the Neern-tree on which it was built, and the under surface was felted with fresh blossoms belonging to the same tree.' Mr. Hume gives the average of sixty eggs as 0·89 inch in length by 0·65 inch in breadth."

THE THIRD SUB-FAMILY OF THE TIMELIIDÆ.—THE TRUE BABBLERS (*Timeliinæ*).

In this group of birds the short rounded wing, remarkable for its concavity, which makes this organ fit close to the body, and so becoming admirably adapted to the bush-creeping habits of the bird, reaches its fullest development in the family of Babbling Thrushes. The largest number of Babblers is met with in the Malayan Peninsula and the neighbouring islands, whence they extend in gradually decreasing numbers towards the Moluccas and New Guinea in the south, and northwards throughout the Burmese countries to Southern China and Formosa, and eastwards through the Indian Peninsula to Ceylon. The distribution of these birds is indeed interesting in the highest degree, for there can be little doubt that the genus *Tutare*, which occurs in the islands of the Pacific Ocean, is properly a member of this sub-family, and it is not until the genus *Bernieria* is met with in Madagascar that any closely-allied generic form is known. Again, the genera *Drymocataphus* and *Trichostoma*, which are considered to be two of the most characteristic forms of the Malayan Peninsula and islands, re-appear once more in the forests of West Africa, evincing another proof of the affinity which exists between the forest belt which clothes the shores of this part of Africa and the Indo-Malayan region.

The habits of the *Timeliinæ* are for the most part similar, the birds inhabiting the bush and thick underwood, feeding on insects, and living in small flocks, which are constantly on the move, and uttering during their flight a continued chattering or piping note.

THE BUSH BABBLERS.

These are inhabitants of the Old World, and form a very conspicuous group of Thrush-like birds, widely distributed over Africa, and extending over India and the Burmese countries into China. Some of them are of moderately large size, exceeding the dimensions of the Common Thrush, and they are very similar in habits, living in the bushes, and hopping vigorously from bough to bough, a mode of life for which they are well fitted by their strong stout legs.

The habits of the Palestine Bush Babbler are thus described by Canon Tristram:—"It is strictly confined to the larger oases round the Dead Sea, and is well known to European residents as the 'Hopping Thrush' of Jericho, and is evidently the 'Mocking-bird' of Lynch's 'Narrative.' It is abundant in the rich oases of Ain Sultan and Ain Duk, at the north-west of the Dead Sea, in the sultry corner at the north-east, under the hills of Moab (the ancient plain of Shittim), and at the south-east end, in the luxuriant tangles of the Safich. A few inhabit the shrubs of Engedi, and we found it once or twice at the Wady Zuweirah, at the south-west of the Dead Sea. Nowhere else did it come under our observation, and thus we find a distinct and most characteristic species limited to an area of forty miles by twelve, and not occupying more than ten square miles in the whole of that area, so far as our present knowledge extends. They are most sociable and noisy birds, always in small bands, though not in large flocks, hopping along the ground in a long line, with jerking tail, and then, one after another, running up a bush, where they maintain a noisy conversation till the stranger's approach, when they drop down in single file and run along the ground, to repeat the same proceedings in the next tree. The nest is a large, clumsy structure, placed always in the centre of a thorn-tree, and requiring some little labour with the hatchet to clear a way to it. It is composed entirely of strips of bark loosely woven together, and without any other lining. One in my collection looks much like a very large nest of Savi's Warbler, from this peculiarity of the employment of but a single material. The eggs are four to six in number, dark rich green, smaller than those of the Common Thrush, and a little larger than the eggs of *Crateropus fulvus*. The parent birds continue their attention to the young for some time after they leave the nest; and I have been amused in watching the manner in which the old bird will remain at the top of a bush, scolding and screaming at the intruder till all her brood have dropped down one after another, and are running

to the next tree, when she suddenly runs down and follows them in silence, to repeat the same manœuvre so long as she is followed. Their food consists principally, if not entirely, of the berries of the zizyphus, or jujube, which are to be found at all seasons of the year."

THE BOWER BIRDS.

Considerable difficulty has been experienced in placing these birds in the natural system; the curious habit possessed by the larger number of this sub-family, of building a bower instead of making a nest, marks them as one of the most singular of all the forms of bird life in existence. The richly-coloured Regent Bird, both from its black and yellow plumage, and from the velvety nature of the

REGENT BIRD. (*After Gould.*)

feathers on the head, shows a certain approach towards the Birds of Paradise, while on the other hand, the Cat birds and true Bower birds are somewhat Thrush-like in appearance. They appear to the writer to be well placed among the Thrush-like birds, albeit very aberrant ones.

THE REGENT BIRD (*Sericulus melinus*).

Concerning the habits of this species, Mr. Gould * writes:—"This beautiful species, one of the finest birds of the Australian fauna, is, I believe, exclusively confined to the eastern portion of the country. It is occasionally seen in the neighbourhood of Sydney, which appears to be the extent of its range to the southward and westward. I met with it in the bushes at Maitland in company, and feeding on the same trees with the Satin and Cat birds and the *Mimeta viridis*. It is still more abundant on the Manning at Port Macquarie, and at Moreton Bay. I sought for and made every inquiry respecting it at Illawarra, but did not meet with it, and was informed that it is never seen there, yet the district is precisely similar in character to those in which it is abundant, about two degrees to the eastward. While encamped on Mosquito Island,

* "Handbook to the Birds of Australia."

near the mouth of the River Hunter, I shot several, and observed it to be numerous on the neighbouring islands, particularly Baker's Island, where there is a fine garden, and where it commits serious injury to the fruit crops. Although I have spoken of this bird as abundant in the various localities referred to, I must mention that at least fifty out of colour may be observed to one fully plumaged male, which, when adorned in its gorgeous livery of golden-yellow and deep velvety-black, exhibits an extreme shyness of disposition, as if conscious that its beauty, rendering it a conspicuous object, might lead to its destruction. It is usually therefore very quiet in its actions, and mostly resorts to the topmost branches of the trees; but when two gay-coloured males meet, conflicts frequently take place. To obtain specimens in their full dress considerable caution is necessary; on the

SATIN BOWER BIRD.

other hand, females and immature males are very tame, and, when feeding among the foliage, appear to be so intent upon their occupation as not to heed the approach of an intruder; and I have occasionally stood beneath a low tree, not more than fifteen feet high, with at least ten feeding voraciously above me. I did not succeed in discovering the nest; but the late F. Strange, writing from Moreton Bay, informed me that it is rudely constructed of sticks, no other material being employed, not even a few roots as a lining. On the 4th of November I observed one building, and as I was leaving for Richmond the next day, I gave instructions that it should be taken fifteen days after; when the time arrived, however, no native could be got to secure it, and it remained till my return on the 4th of December. I then sent a native up, and he brought me the nest, with two young ones covered with down, except the wings, which were feathered. As the two birds quite filled the nest, and I have heard of other nests being taken with the same number of birds in them, I am inclined to believe that two is the normal number of eggs laid. After taking the young, I wounded and succeeded in capturing the old bird, which, after being two days in confinement, became reconciled to captivity, attended to

her progeny, fed them, and removed the dirt that accumulated in the nest. The eggs are still a desideratum, and their acquisition would be a source of much gratification to me. The following extract from a paper on the habits of this fine bird, by C. Coxen, Esq., of Brisbane, read at a meeting of the Queensland Philosophical Society on the 23rd of May, 1864, I consider to be of high interest, as affording a clue to the position the bird should occupy in our system :—'Although the Regent-bird has been known to ornithologists for many years, very little of its habits has become known, and it has been left for me to bring under notice the very peculiar and curious habit it enjoys in common with the Satin-bird (*Ptilonorhynchus* holosericeus*) and the spotted Bower-bird (*Chlamyloderat maculata*). My attention was called to this peculiarity in August last, by Mr. Waller, taxidermist, of Edward Street, in this city, to whose untiring energy and ability as a collector I must always bear testimony. Mr. Waller informed me that while shooting in a scrub on the banks of the Brisbane River, he saw a male Regent-bird playing on the ground, jumping up and down, puffing out its feathers, and rolling about in a very odd manner, which occasioned much surprise, never having seen the bird on the ground before. The spot where it was playing was thickly covered with small shrubs. Not wishing to lose the opportunity of procuring a specimen, he fired, but only succeeded in wounding it; and on searching the spot he found a bower formed between, and supported by two small brush plants, and surrounded by small shrubs—so much so, that he had to creep on his hands and knees to get to it. While doing so, the female bird came down from a lofty tree, uttered her peculiar note, and lit on a branch immediately over the bower, apparently with the intention of alighting in front of it, but was scared away on seeing Mr. Waller so close to her. She continued flitting over the place, and calling for her mate so long as he was in the neighbourhood. Mr. Waller believes that the male bird, after being wounded, fluttered to some distance from the bower, and died, as a male Regent-bird was found dead two days afterwards in a more open part of the brush. On visiting the scrub on the following and several successive days, the female bird was seen in the locality of the bower, and by her constant calling was apparently lamenting the loss—or what might seem to her the inconstancy—of her mate. The ground around the bower was clear of leaves for some twelve or eighteen inches, and had the appearance of having been swept, the only objects in its immediate vicinity being a small specimen of Helix. The structure was alike at both ends, but the part designated as the front was more easy of approach, and had the principal decorations; the approach to the back being more closed by scrub. Mr. Waller being desirous that this curious habit of the Regent-bird should be verified, determined to leave the bower untouched until he had acquainted me with his discovery. Circumstances occurred to prevent me from accompanying him to its whereabouts until the following November, when we found the bower in good preservation. Previous to my seeing and examining the structure, I must confess to having had considerable doubts as to whether it would not prove to be a bower of the Satin-bird, but these doubts were dissipated at the first glance, the formation of the structure differing considerably, and the decoration more so. With Mr. Waller's assistance I removed the building without injuring or in any way defacing its architectural style. It may not be inopportune for me to state that I was the first to discover the bower and habits of the Satin-bird, and also among the first discoverers of the bower of the spotted Bower-bird, that I have had frequent opportunities of seeing them in the New South Wales brushes and the myall scrubs to the westward, and am consequently conversant with their peculiarities. The bower of the Regent-bird differs from the Satin-bird's in being less dome-shaped, straighter in the sides, platform much less, being only ten inches by ten, but thicker in proportion to its area, twigs smaller and not so arched, and the inside of the bower smaller: indeed, I believe, too small to admit an adult Satin-bird without injury to its architecture. The decorations of the bower are uniform, consisting only of a small species of Helix, herein forming a marked contrast from the Satin-bird. Mr. Gould has shown his usual power of observation and knowledge of generic distinctions in having placed the Regent-bird next in order to the Satin Bower-bird, without having any knowledge of its peculiar building instincts. The Regent-bird frequents our river scrubs during the winter months, from the beginning of May to the end of September, coming from the south, whither he repairs during the summer. Its food consists of berries, wild fruits, and insects. In confinement it greedily disposes of house-flies, cockroaches, and small insects, showing great activity in their capture; but its

* πτίλον, a feather; ῥύγχος, a bill.

† χλαμύς, a mantle; δέρη, a neck.

principal food is the banana, of which it eats largely. It is very bold and pugnacious, the young males particularly so. In confinement several cases have occurred of one having killed the other. The young males closely resemble the females in plumage during their first year, in the second they partially assume the gay plumage of their sire, and in their third year they put on the full livery of the adult male.' "

The male has the head and back of the neck, running in a rounded point towards the breast, rich bright gamboge-yellow, tinged with orange, particularly on the centre of the forehead; the remainder of the plumage, with the exception of the secondaries and inner webs of all but the first primary, deep velvety-black; the secondaries bright gamboge-yellow, with a narrow edging of black along the inner webs; the first primary is entirely black, the next have the tips and outer webs black; the half of the inner web and that part of the shaft not running through the black tip are yellow; as the primaries approach the secondaries, the yellow of the inner web extends across the shaft, leaving only a black edge on the outer web, which gradually narrows until the tips only of both webs remain black; bill yellow; irides pale-yellow; legs and feet black.

The female has the head and throat dull brownish-white, with a large patch of deep black on the crown; all the upper surface, wings, and tail, pale olive-brown, the feathers of the back with a triangular-shaped mark of brownish-white near the tip; the under surface is similar, but here, except on the breast, the white markings increase so much in size as to become the predominant hue; eyes brown; bill and feet black.

THE FOURTH SUB-FAMILY OF THE TIMELIIDÆ.—THE GRASS-WARBLERS (*Cisticolinæ*).

In this sub-family must be placed the large group of Grass Warblers, or Fantails, which are largely developed in the African continent, and range throughout Southern Europe and the whole of the Indian region, extending even into Australia. One of the best known species is

THE COMMON FANTAIL WARBLER (*Cisticola cursitans*).

This bird is spread over the whole of Southern Europe, over the whole of Africa, India, and China, and is remarkable for the beautiful nest which it makes, and for the great variety in the colouring of its eggs. Captain Vincent Legge writes to Mr. Hume from Ceylon:—"It breeds in the western province from May until September, and constructs its nest either in paddy-fields or in *Guinea*-grass plots attached to bungalows. The nest is so beautiful and so neatly constructed that perhaps a short description of it will not be out of place. A framework of cotton or other fibrous material is formed round two or three upright stalks, about two feet from the ground, the material being sown into the grass, and passed from one stalk to another until a complete nest is made. This takes the bird from one to two days to construct. Several blades, belonging to the stalks round which the cotton is passed, are then bent down and interlaced across to form a bottom, on which, and inside the cotton network, a neat little nest of fine strips of grass torn off from the blade is built. This is most beautifully lined with cotton or other downy substance, which appears to be plastered with the saliva of the bird, until it takes the appearance and texture of soft felt. The average dimensions of the interior, or cup, are two inches in depth by one and a quarter in breadth. The whole structure is generally completed in about five days, and the first egg laid on the fifth or sixth day from the commencement. The number of eggs varies from two to four, most nests containing three. The time of incubation is, as a rule, from nine to eleven days. I have found but little variation in the eggs of this species either as regards size or colour. They are white or pale greenish-white, spotted and blotched in a zone round the larger end with red and reddish-grey, a few spots extending towards the point; axis, 0·63 inch; diameter, 0·51 inch. From close observation I can certify that this and many other small birds do not here sit during the day-time. I scarcely ever found a *Cisticola* on the nest between sunrise and sunset." Mr. Hume himself also observes:—"I have myself taken several, and have had a great many nests sent to me. With rare exceptions, all belonged to one type. The bird selects a patch of dense fine-stemmed grass, from eighteen inches to two feet in height, and, as a rule, standing in a moist place; in this, at the height of from six to eight inches from the ground, the nest is constructed.

The sides are formed by the blades and stems of the grass, *in situ*, closely tacked and caught together with cobwebs and very fine, silky vegetable fibre. This is done for a length of from two to nearly three inches, and, as it were, a narrow tube, from one to one-fifth in diameter, formed in the grass. To this a bottom, from four to six inches above the surface of the ground, is added, a few of the blades of the grass being bent across, tacked and woven together with cobwebs and fine vegetable fibre. The whole interior is then closely felted with silky down—in Upper India usually that of the *Mudar* (*Calotropis Hamiltoni*). The nest thus constructed forms a deep and narrow purse, about three inches in depth, an inch in diameter at top, and one-fifth at the broadest part below. The tacking together of the stems of the grass is commonly continued a good deal higher up on one side than on the other, and it is through or between the untacked stems opposite to this that the tiny entrance exists. Of course, above the nest the stems and blades of the grass meeting together completely hide it. The dimensions above given are those of the interior of the nest; its exterior dimensions cannot be given. The bird tacks together not merely the few stems absolutely necessary to form a side to the nest, but most of the stems all around, decreasing the extent of attachment as they recede from the nest cavity. It does this, too, very irregularly; on one side of the nest perhaps no stem more than an inch distant from the interior surface of the nest will be found in any way bound up in the fabric, while on the opposite perhaps stems fully three inches distant, together with all the intermediate ones, will be found more or less webbed together. Occasionally, but rarely, I have found a nest of a different type. Of these, one was built among the stems of a common prickly labiate marsh-plant, which has mauve and white flowers. There was a straggling framework of fine grass, firmly netted together with cobwebs, and a very scanty lining of down. The nest was egg-shaped, and the aperture on one side, near the top. Mr. Brooks, I believe, once obtained a similar one; but the vast majority of the others that any of us have ever got have been of the type first described, which corresponds closely with Passler's accounts. Five is the usual complement of eggs; at any rate, I have notes of more than a dozen nests that contained this number, and in more than half the cases the eggs were partly incubated. I have no record of more than five; and though I have any number of notes of nests containing one, two, three, and four eggs, yet these latter in almost all these cases were fresh."

Respecting the species in Africa some interesting notes are given in Layard's work on the birds inhabiting the southern part of that continent. Mr. Ayres says that in Natal they are common in the open country, frequenting much shorter grass than that visited by *Drymoica curvirostris*. Their nest is very beautifully constructed amongst the fine stalks of grass, which are drawn together towards the top, a sort of purse, or bag, being made of the finest and whitest down and spiders' webs, and attached at the sides to the grass which surrounds it, the opening being on the top. On any intruder approaching the nest the birds generally mount overhead with a flitting, eccentric flight, watching with anxiety the fate of their domicile. Their flight is tolerably strong; and when they have been disturbed once or twice it is sometimes a difficult matter to get within shot of them. Major Bulger writes from Windovgelberg:—"There is a very tiny bird abundant on the flats all around us here, which we call the 'little grass bird.' It is *Cisticola cursitans*—the smallest feathered creature I have seen in the country, and something like a diminutive Lark in appearance. When started it always rises with a whirr, and flies away, emitting a snapping noise, and occasionally an alarm note; and whilst on the ground amongst the grass, where it is commonly met with, I fancy it not unfrequently makes the same snapping noise, for often, whilst I have been walking on the flats, I have heard this sound, and presently have flushed this 'little grass bird.' It has seemed to me that this Cisticola possesses the power of ventriloquism, for I have remarked on many occasions that although we have heard the peculiar sound produced by this bird around us in every direction, we have never succeeded in finding more than one or two at the most of these little creatures." In his work on the "Birds of Damara Land" the late Mr. Andersson writes as follows:—"This species came under my notice in Great Namaqua Land in about 24° or 25° S. lat. I have also met with it abundantly in Southern Damara Land, and have obtained it in Ondonga. Specimens from Damara Land are of a lighter tint than those from Ondonga, but I have no doubt they are identical. It is common at some large waters on the Omaruru River, but is most difficult to shoot; it can generally only be shot on the wing as it rises, and when shot it invariably falls in the reeds, where its diminutive size easily eludes the eye. It is, however, found in many other situations besides reedy localities, but chiefly among tall, coarse grasses

growing about small periodical water-courses. When disturbed, it rises almost perpendicularly, descending nearly as abruptly, and either burying itself at once in the rank vegetation, or first perching on a grass stalk, and gradually creeping out of view, and also out of reach, for it is difficult to flush it again. The food of this little bird consists of small insects." The Fantail Warbler measures four inches in length. The top of the head and interscapulars are umber-brown, variegated with yellowish-brown; back of neck, back, and shoulders, clear yellowish-brown, with umber-brown streaks;

TAILOR BIRD.

rump, umber-brown; chin and throat, whitish; breast, belly, and vent, sienna-yellow; tail, moderately long, and slightly graduated; two middle feathers, broccoli-brown, margined and tipped with wood-brown; the other feathers brownish-red, broadly tipped with white, with a large umber-brown blotch just before the white, seen, as in all species, most plainly on the inner side; eyes light brown.

THE TAILOR BIRD (*Orthotomus* sutorius*).

This is a well-known Asiatic bird, occurring throughout the whole of the Indian Peninsula, the Burmese countries, and China.† It is most common in well-wooded districts, frequenting gardens, hedgerows, orchards, low jungle, and even now and then the more open parts of high-tree jungles. It is usually found in pairs, at times in small flocks, incessantly hopping about the branches of trees, shrubs,

* ὀρθός, straight; τομός (τέμνω), cutting.

† Jerdon, "Birds of India," Vol. II., p. 166.

pea-rows, and the like, with a loud reiterated call; and picking various insects, chiefly ants, cicadellæ, and various small larvæ, off the bark and leaves, and not unfrequently seeking them on the ground. It has the habit of raising its tail whilst feeding and hopping about, and at times, especially when calling, it raises the feathers and displays the concealed black stripe on its neck. The ordinary note of the Tailor is *to-wee-to-wee-to-wee;* or as syllabised by Layard *pretty-pretty-pretty;* when alarmed or angry, it has a different call. It is a familiar bird, venturing close to houses, but when aware that it is being watched it becomes wary and shy. Mr. Hume gives a very full account of the nests, from which the Tailor-bird derives its well-known name. "In India the breeding season lasts from May to August, both months included; but in the plains more nests are to be found in July, and in the hills more, I think, in June, than during the other months. The nest has been often described and figured, and, as is well known, is a deep soft cup enclosed in leaves, which the bird sews together to form a receptacle for it. It is placed at all elevations, and I have as often found it high upon a Mango tree as low down amongst the leaves of the edible egg plant (*Solanum esculentum*). The nests vary much in appearance, according to the number and description of leaves which the bird employs, and the manner in which it employs them; but the nest itself is usually chiefly composed of fine cotton wool, with a few horsehairs, and, at times, a few very fine grass stems as a lining, apparently to keep the wool in its place, and enable the cavity to retain permanently its shape. I have found the nests with three leaves fastened, at equal distances from each other, into the sides of the nest, and not joined to each other at all. I have found them between two leaves, the one forming a high back, and turned up at the end to support the bottom of the nest, the other hiding the nest in front and hanging down well below it, the tip only of the first leaf being sewn to the middle of the second. I have found them with four leaves sewn together to form a canopy and sides, from which the bottom of the nest depended bare; and I have found them between two long leaves, whose sides, from the very tips to near the peduncles, were closely and neatly sewn together. For sewing they generally use cobwebs, but silk from cocoons, thread, wool, and vegetable fibres are also used. The eggs vary from three to four in number; but I find that out of twenty-seven nests containing more or less incubated eggs, of which I have notes, that exactly two-thirds contained only three, and one-third four eggs. About the colour of the eggs there has been some dispute, but this is owing to the birds laying two distinct types of eggs, which will be described below. Hutton's and Jerdon's descriptions of the eggs, *white* spotted, with rufous or reddish-brown, are quite correct; but so are those of other writers, who call them *bluish-green*, similarly marked. Tickell, who gives them as 'pale greenish-blue, with irregular patches, especially towards the larger end, resembling dried stains of blood, and irregular and *broken lines scratched* round, forming a zone near the larger end,' had of course got hold of the eggs of a *Drymoipus*. I have taken hundreds of both types, and I note that, as in the case of *Buchanga albirictus*, eggs of the two types are never found in the same nest. All the eggs in each nest always belong to one or the other type. The parent birds that lay these very different-looking eggs certainly do not differ; that I have positively satisfied *myself*. I quote an exact description of a nest which I took at Bareilly, and which was recorded on the spot. Three of the long ovato-lanceolate leaves of the mango, whose peduncles sprang from the same point, had been neatly drawn together with gossamer threads run through the sides of the leaves, and knotted outside, so as to form a cavity like the end of a netted purse, with a wide slit on the side nearest the trunk, beginning near the bottom, and widening upwards. Inside this, the real nest, nearly three inches deep, and about two inches in diameter, was neatly constructed of wool and fine vegetable fibres, the bottom being thinly lined with horsehair. In this lay three tiny delicate bluish-white eggs, with a few pale reddish-brown blotches at the large ends, and just a very few spots and specks of the same colour elsewhere." The male Tailor-bird measures six and a half inches in length, and has the two centre tail feathers lengthened, and measuring three and a half inches, whereas in the female these long feathers are not found, and the tail measures only two inches. The general colour is olive-greenish, the wings being brown edged with green; the crown of the head is rufous, inclining to grey on the nape; the tail is narrow, light brown, with a green tinge, the outer feathers narrowly tipped with white; under surface of body white, with a concealed black spot on each side of the throat formed by the bases of some of the feathers, and seen only at times; bill horny, the lower mandible pale fleshy; the legs flesh colour; eyes reddish-yellow.

THE FIFTH SUB-FAMILY OF THE TIMELIID.E.—THE AMERICAN BABBLERS (*Mimina*).* THE THRASHERS.

These are a group of American Babbling Thrushes, representing the thick-footed Babblers of the Old World (*Crateropi*), and are not unlike some of the latter in appearance. They have the bill slender, like that of a Thrush, or else long and arched; the feet are strong,. and in most of them rather long; the tail is rounded and slightly graduated, and is of a moderate length. As an example of this sub-family may be taken the Brown Thrasher of North America.† This Thrush is a common species throughout a widely-extended area, from the Rocky Mountains to the Atlantic, and from the Red River country in British America to the Rio Grande; and nearly throughout the entire territory it also resides and breeds, from Texas to the fifty-fourth parallel of latitude. It reaches New England early in May, and leaves it in the latter part of September or the first week of October, its stay varying with the season and the supply of its food. It is somewhat irregularly distributed—common in some parts of this section, and rare, or even unknown, in others. It is not found near the sea-coast beyond Massachusetts. It passes the winter in the Southern States, even as far to the north as Virginia, and is in full song in the neighbourhood of Savannah as early as the 1st of March. The song of this Thrush is one of great beauty, and is much admired by all who appreciate woodland melody of the sweetest and liveliest type. It is loud, clear, emphatic, full of variety and charm. Its notes are never imitative, and cannot be mistaken by any one who is familiar with them for those of any other bird, unless it may be some one of its western congeners. It is a very steady performer, singing for hours at a time. Its notes are given in a loud tone, and its song may often be heard to quite a distance. In obtaining its food the Brown Thrush is at times almost rasorial in its habits. In the early spring it scratches among the leaves of the forest for worms, coleopterous grubs, and other forms of insect food. By some it is charged with scratching up the hills of early corn, but this is not a well-founded accusation. Berries of various kinds also form a large part of its food, and among these the small fruit of the gardens must be included. "This Thrush," says Dr. Brewer, "is a very affectionate and devoted bird, especially to its young. It is also prompt in going to the assistance of others of its species when in trouble. Whenever intruders approach their nests, especially if their young are far advanced, they manifest the deepest anxiety, sometimes even making a vigorous defence. The writer has a very distinct recollection of having encountered, together with a younger brother, an ignominious defeat when making his first attempt to inspect the nest of one of these birds. The Brown Thrush is jealous of the intrusion of other birds of its own species to a too close proximity to its nesting-place, and will assert its love of seclusion by stout battles. In Louisiana the construction of the nest is commenced quite early in March, in Pennsylvania not until May, and in the New England States in the latter part of that month. The nest is usually not more than two or three feet from the ground. It is built in a low bush, on a cluster of briars, or among vines. I have known it to be placed in the interior of a heap of brushwood loosely thrown together. I have never met with the nest built upon the ground, but in Springfield and in other dry and sandy localities this is by no means an uncommon occurrence. These nests are frequently placed in close proximity to houses, and sometimes in the very midst of villages. The nest of the Thrasher is large, and roughly but strongly built. The base is usually made of coarse twigs, sticks, and ends of branches, firmly interwoven. Within this is constructed an inner nest, composed of dried leaves, strips of bark, and strong, black fibrous roots. These are lined with finer roots, horsehair, an occasional feather, &c. The eggs are usually four, sometimes five, and rarely six in number. They vary both in the tints of the ground colour and those of their markings, and slightly in their shape. Their length varies from ·99 to 1·12 inch, with a mean of 1·05; their breadth ranges from ·76 to ·87 of an inch, mean breadth ·81. The ground colour is sometimes white, marked with fine reddish-brown dots, confluent at the larger end or forming a broad ring around the crown. In others the markings have a yellowish-brown tint. Sometimes the ground colour is a light green."

THE MOCKING-BIRDS.

These are also exclusively American, and are distributed over the whole continent, from the far north down to the most southern part of South America. They are well known for their admirable

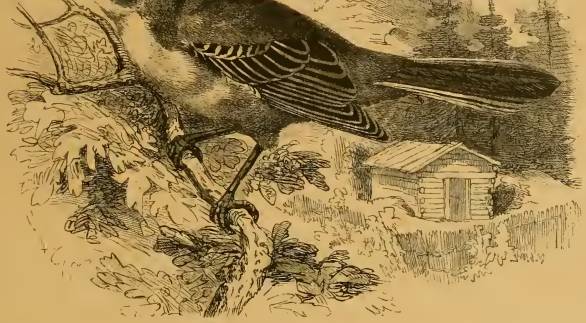
* μίμος, a mimic. † Brewer, in "The History of North American Birds," Vol. I., p. 38.

powers of song, which place them on an equal rank with the Thrushes and Nightingale of the Old World, although their concave wings show their affinities to the Babbling Thrushes. For an account of their habits one must turn to the pages of Audubon,* from which the following remarks are copied verbatim :—

"It is where the great magnolia shoots up its majestic trunk, crowned with evergreen leaves, and decorated with a thousand beautiful flowers that perfume the air around; where the forests and fields are adorned with blossoms of every hue; where the golden orange ornaments the gardens and groves; where bignonias of various kinds interlace their climbing stems around the white-flowered stuartia, and mounting still higher, cover the summits of the lofty trees around, accompanied with innumerable vines that here and there festoon the dense foliage of the magnificent woods, lending to the vernal breezes a slight portion of the perfume of their clustered flowers; where a genial warmth seldom forsakes the atmosphere; where berries and fruits of all descriptions are met with at every step: in a word, kind reader, it is where Nature seems to have paused as she passed over the earth, and, opening her stores, to have strewn with unsparing hand the diversified seeds from which have sprung all the beautiful and splendid forms which I should in vain attempt to describe, that the Mocking-bird should have fixed its abode, there only that its wondrous song should be heard. But where is that favoured land? It is in this great continent. It is, reader, in Louisiana that these bounties of Nature are in the greatest perfection. It is there that you should listen to the love-song of the Mocking-bird, as I at this moment do. See how he flies round his mate, with motions as light as those of a butterfly! His tail is widely expanded, he mounts in the air to a small distance, describes a circle, and, again alighting, approaches his beloved one, his eyes gleaming with delight, for she has already promised to be his and his only. His beautiful wings are gently raised, he bows to his love, and again towering upwards, opens his bill and pours forth his melody, full of exultation at the conquest which he has made. They are not the soft sounds of the flute or of the hautboy that I hear, but the sweeter notes of Nature's own music. The mellowness of the song, the varied undulations and graduations, the extent of its compass, the great brilliancy of execution, are unrivalled. There is probably no bird in the world that possesses all the musical qualifications of this king of song, who has derived all from Nature's self. Yes, reader, all! No sooner has he again alighted, and the conjugal contract has been sealed, than, as if his breast was about to be rent with delight, he again pours forth his notes with more softness and richness than before. He now soars higher, glancing around with a vigilant eye, to assure himself that none has witnessed his bliss. When these love scenes, visible only to the ardent lover of Nature, are over, he dances through the air, full of animation and delight, and as if to convince his lovely mate that to enrich her hopes he has much more love in store, he that moment begins anew, and imitates all the notes which Nature has imparted to the other songsters of the grove. For a while each long day and pleasant night are thus spent; but at a peculiar note of the female he ceases his song and attends to her wishes. A nest is to be prepared, and the choice of a place in which to lay it is to become a matter of mutual consideration. The orange, the fig, the pear tree of the gardens are inspected; the thick briar patches are also visited. They appear all so well suited for the purpose in view, and so well does the bird know that man is not his most dangerous enemy that, instead of retiring from him, they at length fix their abode in his vicinity, perhaps in the nearest tree to his window. Dried twigs, leaves, grasses, cotton, flax, and other substances are picked up, carried to a forked branch, and there arranged. Five eggs are deposited in due time, when the male, having little more to do than to sing his mate to repose, attunes his pipe anew. Every now and then he spies an insect on the ground, the taste of which he is sure will please his beloved one. He drops upon it, takes it in his bill, beats it against the earth, and flies to the nest to feed and receive the warm thanks of his devoted female. When a fortnight has elapsed the young brood demand all their care and attention. No cat, no vile snake, no dreaded hawk, is likely to visit their habitation. Indeed, the inmates of the next house have by this time become quite attached to the lovely pair of Mocking-birds, and take pleasure in contributing to their safety. The dew-berries from the fields, and many kinds of fruit from the gardens, mixed with insects, supply the young as well as the parents with food. The brood is soon seen emerging from the nest, and in another fortnight, being now able to fly with vigour, and to provide for themselves, they leave the parent

* "Birds of North America," Vol. II., p. 187.

birds, as many other species do. The above account does not contain all that I wish you to know of the habits of this remarkable songster, so I shall shift the scene to the woods and wilds, where we shall examine it more particularly. The Mocking-bird remains in Louisiana the whole year. I have observed with astonishment that towards the end of October, when those which had gone to the Eastern States—some as far as Boston—have returned, they are instantly known to the 'Southrons,' who attack them on all occasions. I have ascertained this by observing the greater shyness exhibited by the strangers for weeks after their arrival. This shyness, however, is shortly over, as well as the animosity displayed by the resident birds, and during the winter there exists a great appearance of sociality among the united tribes. In the beginning of April, sometimes a fortnight earlier, the Mocking-birds pair and construct their nests. In some



MOCKING BIRD.

instances they are so careless as to place the nest between the rails of a fence directly by the road. I have frequently found it in such places, or in the fields, as well as in briars, but always so easily discoverable that any person desirous of procuring one might do so in a very short time. It is coarsely constructed on the outside, being there composed of dried sticks of briar, withered leaves of trees, and grasses, mixed with wool. Internally it is finished with fibrous roots, disposed in a circular form, but carelessly arranged. The female lays from four to six eggs the first time, four or five the next, and when there is a third brood, which is sometimes the case, seldom more than three, of which I have rarely found more than two hatched. The eggs are of a short oval form, light green, blotched and spotted with amber. The young of the last brood, not being able to support themselves until late in the season, when many of the berries and insects have become scarce, are stunted in growth, a circumstance which has induced some persons to imagine the existence in the United States of two species of Common Mocking-bird, a larger and a smaller. This, however, as far as my observation goes, is not correct. The first brood is frequently brought to the bird-market in New Orleans as early as the middle of April. A little farther up the country they are out by the 15th of May. The second brood is hatched in July, and the third in the latter part of September. The nearer you approach to the

sea shores, the more plentiful do you find these birds. They are naturally fond of loose sands, and of districts scantily furnished with small trees or patches of briars and low bushes. During incubation the female pays such precise attention to the position in which she leaves her eggs when she goes to a short distance for exercise and refreshment, to pick up gravel, or roll herself in the dust, that, on her return, should she find that any of them have been displaced or touched by the hand of man, she utters a low, mournful note, at the sound of which the male immediately joins her, and they are both seen to condole together. Some people imagine that on such occasions the female abandons the nest; but this idea is incorrect. On the contrary, she redoubles her assiduity and care, and scarcely leaves the nest for a moment; nor is it until she has been repeatedly forced from the dear spot, and has been much alarmed by frequent intrusions, that she finally and reluctantly leaves it. Nay, if the eggs are on the eve of being hatched she will almost suffer a person to lay hold of her.

"Different species of snakes ascend to their nests, and generally suck the eggs or swallow the young; but on all such occasions, not only the pair to which the nest belongs, but many other Mocking-birds from the vicinity, fly to the spot, attack the reptiles, and in some cases are so fortunate as either to force them to retreat or deprive them of life. Cats that have abandoned the houses to prowl about the fields in a half wild state are also dangerous enemies, as they frequently approach the nest unnoticed, and at a pounce secure the mother, or at least destroy the eggs or young, and overturn the nest. Children seldom destroy the nests of these birds, and the planters generally protect them. So much does this feeling prevail throughout Louisiana, that they will not willingly permit a Mocking-bird to be shot at any time. In winter, nearly all the Mocking-birds approach the farm-houses and plantations, living about the gardens or outhouses. They are then frequently seen on the roofs and perched on the chimney-pots; yet they always appear full of animation. Whilst searching for food on the ground their motions are light and elegant, and they frequently open their wings as butterflies do when basking in the sun, moving a step or two, and again throwing out their wings. When the weather is mild the old males are heard singing with as much spirit as during the spring or summer, while the younger birds are busily engaged in practising, preparatory to the love season. They seldom resort to the interior of the forest, either during the day or by night, but usually roost among the foliage of evergreens in the immediate vicinity of houses in Louisiana, although in the Eastern States they prefer low fir-trees.

"The flight of the Mocking-bird is performed by short jerks of the body and wings, at every one of which a strong twitching motion of the tail is perceived. This motion is still more apparent while the bird is walking, when it opens its tail like a fan and instantly closes it again. The common cry or call of this bird is a very mournful note, resembling that uttered on similar occasions by its first cousin, the *Orpheus rufus*, or, as it is commonly called, the *French Mocking-bird*. When travelling, this flight is only a little prolonged, as the bird goes from tree to tree, or at most across a field, scarcely, if ever, rising higher than the top of the forest. During this migration it generally resorts to the highest parts of the woods near water-courses, utters its usual mournful note, and roosts in these places. It travels mostly by day. Few Hawks attack the Mocking-birds, as on their approach, however sudden it may be, they are always ready not only to defend themselves vigorously and with undaunted courage, but to meet the aggressor half-way, and force him to abandon his intention. The only Hawk that occasionally surprises it is the *Astur cooperii*, which flies low with great swiftness, and carries the bird off without any apparent stoppage. Should it happen that the ruffian misses his prey, the Mocking-bird in turn becomes the assailant, and pursues the Hawk with great courage, calling, in the meantime, all the birds of its species to its assistance; and although it cannot overtake the marauder, the alarm created by their cries, which are propagated in succession among all the birds in the vicinity, like the watchwords of sentinels on duty, prevents him from succeeding in his attempts.

"The musical powers of this bird have often been taken notice of by European naturalists and persons who find pleasure in listening to the song of different birds whilst in confinement or at large. Some of these persons have described the notes of the Nightingale as occasionally fully equal to those of our bird, but to compare her essays to the finished talent of the Mocking-bird is, in my opinion, quite absurd. The Mocking-bird is easily reared by hand from the nest, from which it ought to be

removed when eight or ten days old. It becomes so very familiar and affectionate that it will often follow its owner about the house. I have known one raised from the nest kept by a gentleman at Natchez that frequently flew out of the houses, poured forth its melodies, and returned at sight of its keeper. But notwithstanding all the care and management bestowed upon the improvement of the vocal powers of this bird in confinement, I never heard one in that state produce anything at all approaching in melody to its own natural song. The male bird is easily distinguished in the nest as soon as the brood is a little fledged, it being larger than the female and showing more pure white. It does not shrink so deep in the nest as the female does at the sight of the hand which is about to lift it. Good singing birds of this species often bring a high price. They are long-lived and very agreeable companions. Their imitative powers are amazing, and they mimic with ease all their brethren of the forests or of the waters, as well as many quadrupeds. I have heard it asserted that they possess the power of imitating the human voice, but have never met with an instance of the display of this alleged faculty."

THE TENTH FAMILY OF THRUSH-LIKE PERCHING-BIRDS.—THE SHRIKES (*Laniidæ*).

The Shrikes, or Butcher Birds, from their savage habits as well as from their strong hooked bills, were placed by Linnæus and the old authors in close proximity to the birds of prey. They have all very strong and powerful feet, and many of them capture living prey, such as small birds, mice, &c., but as a rule they are insect-feeders. Representatives of the Shrikes are found in every quarter of the globe, excepting South America. The first group of the Shrikes to be noticed are the Australian Thickheads (*Pachycephala*), which are distributed all over that continent, New Guinea, and the Moluccas, and throughout Oceania. Mr. Gould states that "their habits differ from those of most other insectivorous birds, particularly in their quiet mode of hopping about and traversing the branches of trees in search of insects and their larvæ. Caterpillars constitute a great portion of their food, but Coleoptera and other insects are not rejected. The more gaily attired species resort to the flowering *Acaciæ*, *Eucalypti*, and other stately trees, while the more dull-coloured frequent the ground. They all build a neat, round, cup-shaped nest, and the eggs are generally four in number. Their powers of flight are not great; some enjoy a wide range of habitat, while others are extremely local. The song of some is loud and rather pleasing, while others merely emit a whistling note, slowly but frequently repeated." "The Grey-tailed Thickhead," according to the same author, "frequents the vast forests of *Eucalypti* that cover the greater part of Tasmania, and, although it is rather thinly dispersed, is to be met with in every variety of situation, the crowns of the hills and the deep and most secluded gullies being alike visited by it. It frequently descends to the ground in search of insects, but the leafy branches of the trees, particularly those of a low growth, are the situations to which it gives the preference. The adult male, like most other birds of attractive plumage, is of a shy disposition: hence there is much more difficulty in obtaining a glimpse of that sex in the woods than of the sombre-coloured and comparatively tame female, or even of the young males of the year, which during this period wear a similar kind of livery to that of the latter. The actions of this species are somewhat peculiar, and unlike those of most other insectivorous birds; it pries about the leafy branches of the trees, and leaps from twig to twig in the most agile manner possible, making all the while a most scrutinising search for insects, especially Coleoptera. When the male exposes himself, as he occasionally does, on some bare twig, the rich yellow of his plumage, offering a strong contrast to the green of the surrounding foliage, renders him a conspicuous and doubtless highly attractive object to his sombre-coloured mate, who generally accompanies him. It sometimes resorts to the gardens and shrubberies of the settlers, but much less frequently than might be supposed, when we consider that the neighbouring forests are its natural place of abode. The Grey-tailed Thickhead utters a loud whistling call of a single note, several times repeated, by which its presence is often detected. I was unsuccessful in my search for its nest, and the eggs are still desiderata to my collection."

The Great Grey Shrike (*Lanius excubitor*) is an occasional visitant to England, but has not yet been known to breed in that country. The occurrences reported of its capture point to it as a winter migrant only, and at this season of the year it was observed by the writer on more than one occasion in Heligoland. It is one of the largest of the whole family of Shrikes, and is altogether a

powerful bird. The name of Butcher Bird is given to this and other species of Shrikes on account of the habit which these birds have of spitting their prey upon thorns, and often quite a collection of victims may be seen impaled upon a hedge, so as to form what is popularly called a "Shrike's Larder." The food of the present species consists of field mice, beetles, grasshoppers, frogs, lizards, and blind worms, but it will also devour small birds, and even rob nests. As an instance of its pertinacity in capturing its food may be quoted the following note by a German naturalist,* Mr. Carl Müller :—"During this winter I had the opportunity of often observing a Great Grey Shrike. He lorded it over a considerable tract, and, Shrike-like, preferred the hedges and young lime-trees skirting an avenue, where, emboldened by hunger and the severe weather, he watched for his prey, undisturbed by the passers-by. I often saw him fly a considerable distance, then suddenly rise in his flight and hover over one spot. Once when flying along he observed a mouse; he turned sharply round, and, hovering, commenced a careful examination of the ground; and his watchfulness and perseverance astonished me. Now he would hover from thirty to forty feet above the ground, now only ten to fifteen feet; then flying down to a small mound, he would sit with outstretched neck and eager glance, carefully surveying every spot near him, and after watching for a time would again take to wing. For more than ten minutes he waited and searched for the mouse, and then flew off to a thorn-bush about one hundred yards distant. But he had not given up the chase, for after a short rest he again returned to where he had first observed the animal, and repeated the search. He persevered even longer than before, and at last secured his prey by a quick surprise and several hard blows with the bill, delivered as he was hopping and fluttering over it. This Shrike once attacked a Blackbird I used to feed, which had become quite tame. He came behind it as it was feeding, threw it on its back, and, holding it fast with his claws, gave it repeated blows on the head with his beak, and, had I not hastened to the rescue, would soon have killed it. It may not be generally known that the Shrike is attracted to its prey not only by sight, but also by the sense of hearing. I have seen him hunt by ear after a young Lark, neglected by its parents, crouched in the grass calling for food, or a young Goldfinch sitting chirping on the ground; and he is well acquainted with the difference in the call-note of young and old birds. The note of the Great Grey Shrike is harsh. Naumann very correctly describes it as follows:—'Its cry is *schäch, schäch*, and the call-note *trui*. On bright winter days, and particularly in spring, it may be heard uttering a sort of song composed of low notes mixed with its call-note; and it often also mixes with its song the notes of small birds. Both male and female sing, and they often call like the Skylark. Its nest is generally placed at some height on a tree or large thorn-bush, and is somewhat bulky and loose-looking, though the inside is carefully finished. The foundation and outside are composed of dry sticks and twigs, straws and moss; and it is lined with wool and hair.'" The Great Grey Shrike is about nine and a half inches in length, and is of a light blue-grey colour, with the lower region of the eye and ear-coverts black, separated from the grey of the head by a thin white eyebrow and frontal band; the cheeks and under surface of the body are white; the wings are black, with white tips to the quills, and a broad double band of white formed by the bases of the primaries and outer secondaries; the scapulars are tipped with white; tail black, with white tips increasing in extent towards the outermost feathers, which are almost entirely white. Bill black; legs slender, dark brownish-black.

THE ELEVENTH FAMILY OF THRUSH-LIKE PERCHING BIRDS.—THE GREENLETS (*Vireonidæ*).

These constitute a small American family, which have apparently much in common with the Shrikes. The bill is notched in both mandibles, the tail consists of ten feathers, and the tarsi are scaled in front. The name Greenlet well illustrates the prevailing colour of their plumage. In Jamaica one of the Greenlets was described by Brown many years ago under the name of "Whip-Tom-Kelly;" and Mr. Gosse † writes of the same species (*Vireosylvia calidris*) as follows:—"Much oftener heard than seen, though not unfamiliar to either sense, this sober-coloured bird is one of those whose notes have such a similarity to articulations as to procure them a common appellation. The Fly-catchers, in general, are not very vociferous, but this is pertinacious in its tritonous call, repeating it with energy every two or three seconds. It does not ordinarily sit on a prominent twig or

* "Journal für Ornithologie," 1868, p. 159.

† "Birds of Jamaica," p. 194.

GREAT GREY SHRIKE.

dart out after insects, though I have seen one in eager but unsuccessful pursuit of a Butterfly (*Terias*); but it seems to love the centre of thick trees, where it sits announcing its presence, or flits from bough to bough as you approach, so that it is not easy to get a sight of it. This bird does not winter with us, but leaves, with the Grey Petebary (*Tyrannus dominicensis*), at the beginning of October. It returns early, and, like the bird just named, evidently makes an eastward progress, arriving at the south-west end of the island first. On the 26th of March, on my return to Bluefields, after a visit to Spanish Town, I heard its well-known voice, but my lad had noticed it a week before. From this time every grove—I might almost say every tree—had its bird, uttering with incessant iteration and untiring energy, from its umbrageous concealment, *Sweet-John! John-to-whit! Sweet-John-to-whit! John-t'whit—sweet-John-to-whit!* I can scarcely understand how the call can be written *Whip-Tom-Kelly*, as the accent, if I may so say, is most energetically on the last syllable. Nor have I ever heard this appellation given to it in Jamaica. After July we rarely hear *John-to-whit*, but *to-whit—to-whoo*, and sometimes a soft simple chirp, or *sip sip*, whispered so gently as scarcely to be audible. This, however, I have reason to believe, is the note of the young, for I have heard young ones repeatedly utter it when sitting on a twig, receiving from time to time, with gaping beak and quivering wing, the food contributed by the dam." Mr. Gosse says that the bird feeds on seeds, berries, and insects, building in June and July, and lays three eggs, white, with a few small red-brown spots thinly scattered over the surface, sometimes very minute and few.

THE TWELFTH FAMILY OF THRUSH-LIKE PERCHING BIRDS—THE TITMICE (*Paridæ*).

In this family the bill is short and conical, but without any notch at the tip of the upper mandible; the nostrils are generally concealed by bristles; the tarsi are very distinctly scaled, especially in the freshly-killed birds; the primary quills are ten in number. Titmice are found all over the northern parts of the Old and New World, but disappear in South America; nor are they represented in Australia or Oceania. Only a limited number of species are met with in Africa.

The Titmice may be divided into two sub-families: the true Titmice (*Parinæ*), and the Nuthatches (*Sittinæ*). The Titmice proper are lively and cheerful little birds, and even the murky air of London does not seem to be able to damp the spirits of such an incorrigible little chatterer as the Blue Titmouse, whose cheery note may often be heard even in the squares of the great city, while it has more than once occurred to the author to welcome him in the immediate vicinity of the British Museum, as he threads his way through the smoke-blackened trees in the adjacent gardens. It would not be fair to take one of these dusky London birds and to compare its colours with those of a country cousin, as the differences between them could be accounted for by the nature of the localities which they respectively inhabit; but this subject recalls a very interesting problem in connection with the avi-fauna of the British Islands. It is a notorious fact that the animals and birds which are found in an island long separated from its adjacent continent are generally different in a greater or less degree from their continental relatives.

This circumstance, however, appears to have been strangely overlooked in the case of the British Islands by most ornithologists; and the fact that the British Long-tailed Titmouse was a different species from the Long-tailed Titmouse of the Continent—an assertion which the author published in 1868—was received with incredulity by authorities who would not hesitate to admit similar instances of specific difference if the case occurred in some other portion of the globe than Europe. As a matter of fact, there is scarcely a resident species belonging to the British Islands which does not differ more or less from its Continental representative. Such remarks do not of course refer to migratory birds, which visit all parts of Europe alike, but the generality of the British birds which remain all the year, and do not leave the country, are always duller in colour than specimens of the same species on the Continent. Striking instances of this are seen in the Bullfinch, the Chaffinch, the Yellow-hammer, and many other birds, but the Titmice offer the strongest evidence. The Blue Titmouse, although a sufficiently pleasing bird in its coloration, cannot compare for brilliancy of tint with a specimen shot in France. The Coal Titmouse of England appears to be specifically distinct from the Coal Titmouse of the Continent, which has a blue

back, whereas the British bird (*Parus britannicus*) has the back olive-coloured. The Long-tailed Titmouse of Sweden and Germany (*Acredula caudata* of Linnæus) always has a pure white head, while in the familiar species of Great Britain (*Acredula vagans*) only the top of the head is white, bordered with a broad black stripe on each side.

THE GREAT TITMOUSE, OR OX-EYE (*Parus major*).

This is the largest species of the family found in the British Islands, and is by no means such a sociable bird as the Blue Tit, being generally seen in pairs, and seldom consorting, as does the last-named species, with Creepers, Nuthatches, and other Titmice, which form little parties in the winter and go through the woods in company. It is a very active bird, and its loud notes, which are syllabled by Macgillivray as a harsh chatter, "*Chir-r-r-r-r-ik*," are sure to command attention from any one walking in the woods.* "In spring and the early part of summer its notes bear some resemblance to the sounds produced by a file in sharpening the teeth of a saw, and may be syllabled into *tee-ta, tee-ta, tee-ta, tee-ta.* They are very loud for a bird of so small a size, and may be heard distinctly in calm weather at the distance of eight hundred paces. Its spring notes, Mr. Hepburn writes to me, are first heard about the beginning of March, and continued till the middle of May. In April, 1839, I pursued one of these birds through a narrow plantation. The first note I heard was that of *chur-r-r*, then *chir-r-r*; it then imitated very exactly the twink of the Chaffinch, the alarm notes of the Robin and Wren, and the doleful ditty of the Yellow Bunting; next it produced a note of its own, which it repeated incessantly as it sported amongst the boughs of an old ash; then it seemed to forget this note, and emitted another, which also was soon forgotten; and again, as if tired of its own compositions, it essayed those of its more musical brethren. This Titmouse was a great nuisance to me when I began to study ornithology, often leading me astray by its silly productions, which I thought were the notes of some bird new to me." Like all the species of the genus *Parus*, the Great Titmouse nests in the hole of a tree or of a wall, excavating in the former case the cavity itself. The eggs are sometimes deposited on rotten wood, but the nest is generally composed of grass or moss, above which is a soft bed of hair, wool, or feathers; but occasionally it becomes a very massive structure, as may be gathered from the following account given by Mr. Stevenson in his "Birds of Norfolk":—"The most extraordinary nest of this species that I ever saw or read of was discovered in a plantation at Earlham in the summer of 1859. This natural curiosity, which is carefully preserved in the collection of Mr. John Gurney, of Earlham Hall, was discovered in a rough corner cupboard, fixed at one end of an old shepherd's house erected in a plantation for the use of the gamekeeper. In the centre of the cupboard was a single shelf; and the door being kept shut, the pair of Titmice could only obtain access through a small hole in the woodwork above. Through this opening, however, the enormous amount of materials found must have been introduced bit by bit, until the centre space between the shelf and the top of the cupboard, leaving only just room enough for the hen bird to sit, was filled with a compact mass of twigs, moss, bents, feathers, rabbits' down, horsehair, wool, and even flowering grasses. Moss formed, of course, the chief substance employed; yet so wonderfully had the whole fabric been woven together that, when taken from the shelf upon which it was erected, it retained the exact shape of the three-cornered cupboard, the sides being as firm and neat as a well-kept grass edging levelled with a roller. The following dimensions of this remarkable structure will best give an idea of the skill and labour thus strangely devoted to it by its untiring architects. Length in front 15 inches, height 9 inches, depth from front to back, measured to the angle of the cupboard, 10 inches. In the centre of the upper part was a depression, in which the eggs were laid; and here, in spite of frequent intrusions from curious visitors, the hen bird being even handled on her nest, these little creatures reared five young ones and carried them off in safety. A similar nest, commenced in the previous spring, was unfortunately destroyed; but since the successful completion of the one above mentioned no further attempt has been made to repeat so formidable a task."

The Great Titmouse is about five inches and a half in length. The head, throat, and centre of the body are black, with a large white patch occupying the ear-coverts and the region below the eye; the

* Macgillivray: "British Birds," p. 428.

rest of the under surface is yellow, the under tail-coverts white with dusky centres; the back is green, the wing-coverts blue grey with a white band across, formed by the tips of the greater coverts; the quills are blackish, edged with slaty-grey, becoming white towards the tips; the secondaries are margined with yellow, shading into white towards the ends, the lower back, rump, and upper tail-coverts slaty-grey; the tail blue-grey, the outer feather edged with white; bill black, feet leaden-grey, eye black. The female is like the male, but has the black on the head and throat more dingy, and has the black stripe down the breast less distinctly marked. Young birds may always be told by a tinge of yellow on the cheeks. The range of this species appears to extend throughout the whole of Europe and Northern Asia.

The Long-tailed Titmouse (*Acredula vagans*) belongs to a small genus of birds, distinguished from the true Titmice by their long graduated tails, which consist only of ten feathers. They are found throughout the Palæarctic region, Europe, and Northern Asia. They differ greatly in their mode of nesting, not building, like the *Pari*, in holes of trees or trees, but constructing a most beautiful domed nest, from which circumstance their popular English names of Bumbarrel and Bottle-Tit are derived. "Wonderful, indeed," writes Mr. Gould, "is the architectural skill displayed by the Long-tailed Tit in the construction of its closely-felted nest, so warmly lined with feathers and externally bespangled with lichens. Who can behold it without feeling the highest admiration of the bird's skill and perseverance? If closely inspected, it will be found that the glaucous sides of the lichens are always placed to the light, whereby the exterior is rendered still more beautiful. In the description of the nest given below, it will be found that 2,000 feathers were taken from a single lining. With what care, then, and diligence must the bird search for so many feathers on the surface of the ground! But this is as nothing compared with the amount of invisible cobwebs collected wherewith to attach the decorative bits of litchen to the outside . . . . When these birds [the young] are about ready to fly, they are very different in colour from the adults, and are altogether very singular little creatures—their comparatively short tails, broad bills, thick, fleshy, yellow gape, red-ringed eyes, and white crowns strongly contrasting with the hues of the old birds. When these nestlings leave their cradle for the trees, they sit on the sunny side of the branches, and are there fed by their parents. They soon gain strength, and flit about for their own living; and when night comes on crowd together on a low branch in a huddled heap, resembling a ball of feathers, their united bodies giving out more heat in a mass than if perched singly. In the early morn, when the sun first sends forth his genial rays, these little Tits may often be seen sitting in a row, all facing that luminary, and at other times perched alternately head and tail so regularly as to astonish those who for the first time witness it. A nest taken in the garden of Formosa, near Chiefden, on the 2nd of May, 1861, was of large size and of an oval form, with an entrance in the side near the top. It was composed of moss and cow-hair, outwardly adorned all over with small pieces of lichen affixed by means of gossamer-like fibres and the empty cocoons of spiders' eggs, and so plentifully lined with feathers of various kinds, that on being counted they proved to be about two thousand in number; among them were observed those of the Peacock, Turkey, Partridge, Barn-door Fowl, Greenfinch, Wood Pigeon, Duck, Turtle-dove, Thrush, Blackbird, &c. It contained ten eggs, the total weight of which was 142 grains, their colour white, thinly speckled with pale red."

In his beautiful work Mr. Gould has figured a group of young Long-tailed Titmice, and has given an illustration of a mass of these little birds closely packed together on the branch of a tree. That the species does collect in large numbers, after the fashion of the African Colies and other birds, is proved by the fact, vouched for by Mr. J. H. Gurney, that Mr. Noble, of Darlington, once fired at an object on a tree which he took for a Pheasant, but which proved to be a great ball of Long-tailed Tits. Whether the ordinary Long-tailed Titmouse of France is the same as the British species has not yet been determined; but the bird of Northern Europe and Asia is the White-headed Titmouse (*Acredula caudata*), which is again replaced in Japan by another species (*Acredula trivirgata*), not unlike the British bird. In Spain and Italy the Long-tailed Titmouse (*Acredula irbii*) is distinguished by its grey back; and a specimen of this bird was shot by the author about thirty miles from Paris, who can testify to its having a different note to that of the English species.

The present species is about six inches in length, and has the back and tail black, the outermost white with a black base, the latter increasing on each feather towards the centre of the

GROUP OF EUROPEAN TITMICE, WITH NUTHATCH AND GOLDCRESTS.

tail; scapulars vinaceous red; crown of head white, with a broad black streak on each side, running from beneath the eye and joining the black on the hind neck; sides of face, throat, and breast white; the ear-coverts streaked with dusky; the rest of the under surface vinaceous; wings black; the inner greater coverts tipped with white, and the secondaries externally edged with whitish, the inner ones more broadly so; eyelid orange; bill and feet black; eye dark brown.

The female does not differ from the male, but the young birds are much more dusky in colour than the adults, and have longer tails. This curious fact is witnessed also in the case of some of the Humming-birds.

THE NUTHATCHES (*Sittinæ*).

These birds have longer bills than the Titmice, and their plumage is more compact, that of the last-named birds being rather fluffy. They are all inhabitants of the northern parts of the Old and the New World, being well represented in North America. True Nuthatches also occur in the Himalayas and in the hills of Burmah; in India and the Malayan Islands, the Blue Nuthatches (*Dendrophila*), an outlying representative of which is seen in the Coral-billed Nuthatch (*Hypherpes corallirostris*) of Madagascar; in Australia and New Guinea the Nuthatches belong to a closely-allied

COMMON NUTHATCH.

but distinct genus (*Sitella*). Like the Titmice, these birds build generally in the hole of a tree; but a striking exception to the general rule is exhibited in the British Museum, where there is a nest of the Nuthatch, presented by Mr. Bond, composed entirely of mud, and built into the side of a haystack. Mr. Bond writes:—"I have received this summer from the neighbourhood of East Grinstead a nest built by a pair of Nuthatches, which is so remarkable in its construction, and in the site selected for it, that I think a notice of it is worth recording. It is well known that the Nuthatch almost invariably makes use of a hole, either in a tree or wall, in which to deposit its eggs, and is not, in the strict sense of the word, a nest-builder. In this instance a haystack was selected, and the birds, by pulling out a quantity of the hay, and plastering up the hollow with mud brought from a considerable distance, formed a nest of similar construction to that of a Swallow, but very much larger, with an entrance-hole near the top, and the ends of the hay stems neatly embedded in the mud. The particulars which were sent to me with the nest are shown in the following letter of my correspondent:—

"'East Grinstead, September 8th, 1871.

"'SIR,—The height of the nest from the ground was between five and six feet. The lining was composed of decayed leaves only (enclosed are a few which fell from the nest during the packing).

The birds were observed pulling the hay from the stack, till they had formed a large opening, before they commenced building with mud, which they had to carry about one hundred and fifty yards, that being the nearest point where they could obtain it. My informants (two men working on the farm) say that they saw the birds were building for a very long time, quite six weeks or two months, and they could not understand what the birds were plastering a lot of mud on the stack for.

"'W. May.'

"To this I may add that the nest cut out of the stack weighed as nearly as possible eleven pounds, and measured thirteen inches in length, by eight inches in its greatest breadth, and four inches in thickness. The lining, which my correspondent mistook for dead leaves, was in reality composed of the scaly inner bark of the fir. There were five eggs, one of which was unfortunately broken.

"When we consider the comparatively small piece of mud which can be carried in the bill of a Nuthatch, and the great distance from which it had to be brought in this case, the size and weight of the nest are extraordinary."

In their habits the Nuthatches bear considerable resemblance to the Creepers, although they do not possess the spiny tail of the latter. The bill, too, instead of being thin and curved, is short and wedge-shaped, and is a formidable little organ when used by the bird for the purpose of prising off the bark in order to get at the insects underneath. Often has it occurred to the writer to stand beneath a tree on which a Nuthatch is engaged at work; the first indication of its presence being a loud musical note, *t'wit, t'wit, t'wit*, or the loud and decisive hammering with which the bird prepares to scare the insects which are immediately to become its food. The Tree Creeper flies from tree to tree, invariably commencing at the bottom and working its way towards the top; not so the Nuthatch, which from the high branches of an adjoining elm will visit a row of trees in succession, beginning at the middle or higher branches, along which it runs with great facility, occasionally descending the trunk head downwards, which is a position never adopted by the Tree Creeper. In the winter it consorts with Titmice of various kinds, and joins them in their excursions through the woods. It is, as a rule, not particularly shy, and will often allow of a close approach when busily engaged in detaching a piece of bark, of which material the bird is able to dislodge with its wedge-shaped bill a portion so large as would scarcely be believed by any one not acquainted with the habits of the Nuthatch. The distribution of the English bird is interesting, as it is not the same as the white-breasted species of Northern Europe. It inhabits the British Islands and Central and Southern Europe, extending as far eastward as Persia, and even ranging into South-eastern Siberia. In Europe it occurs in the peninsula of Jutland, but is replaced in the other Danish islands by the white-breasted form, which spreads throughout the whole of Northern Europe and Northern Asia to Japan.

The Common Nuthatch measures about five inches and a half in length. The general colour of the upper parts is slaty-blue, including the wings and the two centre tail-feathers; the remainder of the feathers black, grey at the tips, with a sub-terminal spot of white; a broad black band from the base of the bill running through the eye as far as the nape; under surface of body pale cinnamon, deeper on the flanks: the cheeks and throat white: the under tail-coverts chestnut with white centres; under wing-coverts blackish; bill brownish horn colour, with a yellow spot at the base; legs dull brown, iris brown.

CHAPTER IV.

CREEPERS—HONEY-EATERS—PIPITS AND WAGTAILS—THE AMERICAN CREEPERS—THE AMERICAN WARBLERS.

THE CREEPERS—Small Order—Characteristics—THE COMMON CREEPER—Its Call-note—Macgillivray's Account of its Habits—Nest and Eggs—THE HONEY-EATERS—Distinctive Features—THE TRUE HONEY-EATERS—THE WARTY-FACED HONEY-EATER—Mr. Gould's Description of the Species—THE SUN-BIRDS—Distribution—Mr. Keulemans' Account of their Habits—Canon Tristram on the Jericho Sun-bird—THE SECOND SUB-ORDER OF THE PASSERIFORMES—THE FRINGILLIFORMES, OR FINCH-LIKE BIRDS—Distinctive Features—WAGTAILS AND PIPITS—Characteristics—THE PIED WAGTAIL—Essentially English Bird—Victimised by Cuckoos—Macgillivray's Account of the Wagtail's Habits—Story of a Season Ticket—THE AMERICAN CREEPERS—Difference between the Creepers of the Old and of the New World—THE BANANA QUIT—THE AMERICAN WARBLERS—Compared with their Old World Cousins—THE SUMMER YELLOW BIRD—Dr. Brewer's Account of its Habits.

THE THIRD GROUP OF THE TURDIFORMES—THE CERTHIIMORPHÆ—CREEPERS.

THIS is an order of very small dimensions, the number of species contained within its limits not exceeding fifty. They are all climbing birds, running about the trunks of trees very much after the manner of Woodpeckers: they also resemble the latter in their stiffened tails. The resemblance to a Woodpecker is of course only in the similarity of the creeping habits of the two birds, for there can be no difficulty in recognising a Creeper from its foot, which has not the zygodactyle arrangement of a Woodpecker, but has the toes placed three in front and one behind.

In the Certhiimorphæ the hind toe is very large, the other toes being very slender, long, strongly compressed at the base, and joined to one another as far as the first joint, the claws extremely sharp, strongly compressed, and the middle one not oblique. The bill is very slender and long, being curved in the True Creepers, while it is stout and wedge-shaped in the Nuthatches, so much so that in the last-named birds it becomes a powerful weapon for tapping at the trunks and branches of trees, and for prising off the bark to get at the insects underneath.

THE COMMON CREEPER (*Certhia familiaris*).

The range of this little species is very considerable, as it is found not only over the whole of Europe and Northern Asia, extending as far east as Japan, and southward to the Himalayas, but it also inhabits the whole of North America as far as Mexico. In England it is tolerably plentiful everywhere, and is often to be seen in winter traversing the woods in company with Nuthatches, and the different kinds of Titmice; in the spring and summer it is usually seen in pairs, which keep up a constant call-note, consisting of a single syllable, and generally rather ventriloquial in its nature, so that it often seems to be uttered quite close to the observer when in reality the bird is at some little distance. Once on a cold winter's morning in March, as the writer was engaged in collecting birds in a park at Mongeron, in France, he was considerably startled by hearing close to him a loud and not unmusical song, like that of a Titmouse, not a single bird of the latter family being apparently within sight. After scanning the trees in all directions in search of the songster, who still continued to pour forth his notes at short intervals, the musician was discovered to be none other than a Creeper, who was clinging to the trunk of a tree about ten yards off, and continuing his song at intervals after a short diversion in pursuit of insects. This struck the writer as curious, as he had never heard a Creeper sing in England, nor has he found any one else who has ever done so; but Professor Newton states that during the breeding-season the male utters a song which is loud and pleasing, though not often heard, and pitched in a high, shrill key. The Creeper from Southern Europe has been supposed to be a distinct species from the true *C. familiaris* of Northern Europe, but a comparison of specimens does not bear out this view, though the songless characteristic of the British bird, as compared with the loud song which is possessed by the Continental Creeper, would seem to favour the idea of their being different. In the Riviera, M. Basil Brooke states that the males also sing lustily.

The following is Professor Macgillivray's account of the habits of the Creeper:*—"In winter, should you fall in with a flock of Reguli and Pari scouring a wood, you may be pretty well assured that a few Tree Creepers will be found at no great distance. There, clinging to the rough bark at the base of that old elm, you see one advancing upwards by short jerks. At each movement it emits a shrill but feeble cry. See how it climbs, searching every crevice, now proceeding directly upwards, now winding round the trunk, presently passing behind it, and in a short time appearing on the other side. Observe it well, and you will see that it crouches close to the surface, presses its tail against it, now and then picks something from a cleft, jerks itself forward, never rests for a moment, but it seems in utmost haste, and expresses its anxiety by continually emitting its lisping cry. Yet its efforts are not laborious; it seems to hold on with perfect ease and unconcern, and although it is now half-way up it exhibits no sign of fatigue. There it passes off from the

COMMON CREEPER.

trunk, creeps along a nearly horizontal branch, winding round it, adhering even to its lower surface with its back toward the ground. Having gone as far as it finds convenient, it flies back to the trunk, which it ascends until you lose sight of it among the twigs at the top. What next? Will it creep down again? No. There it comes with headlong flight, glancing like an arrow curves as it comes near the ground, alights at the very root of the next tree, and commences its ascent. You may watch it for an hour, and you will find it as fresh, as lively, and as keen as ever. Should it happen to observe you, and suspect that you mean it no good, it will run up the back of the tree, appearing now and then at the sides, until it is perhaps half-way up, when it will search all parts alike, being free of the apprehension of injury. But now, hearing its friends the Tits and Reguli at a distance, it looks abroad for a moment from the top of the tree, and uttering a few cries, sweeps away in a curving, somewhat undulating course.

"Such, in fact, is the ordinary course of action of the Creeper, which is thus of very peculiar and remarkable habits. It alights at the bottom of a tree, clinging to the bark with its claws, and without a moment's delay begins to ascend, which it does by short starts, leaping forward, as it were, and supporting itself by pressing the tail against the bark. In this manner it proceeds, diligently searching for

* "History of British Birds," Vol. III., p. 36.

insects, which it picks out with the greatest dexterity. Should a person curious to observe its motions go very near, it winds round so as to keep on the further side of the tree, but seldom flies off. Should it meet with a horizontal branch, it can easily proceed along its lower surface, although in that case it usually prefers the sides or upper part. When it has searched the branch it flies off to another, or continues to ascend the stem; and when it has attained the higher branches, it flies off to the base of a neighbouring tree, and thus proceeds unceasingly. Indeed, I have seldom observed one a single moment at rest. Yet, like other birds, it has its period of cessation from labour, and in the breeding-season it is amusing to observe the gambols of a pair, which may be seen chasing each other along the trunk of a tree, perching for a moment on the branches, and then scudding along, all the while emitting their shrill and feeble cries. These birds are easily shot, for, like the Gold-crested Kinglet and Coal Tit, they seem to pay little attention to a person approaching them, insomuch that I have been within six feet of one, which yet did not fly off, but merely crept round to the other side of the tree. While thus employed it utters every now and then a very low chirp, and when flying from one tree to another, repeats this cry more frequently and somewhat more loudly. I suppose that it is destitute of song, never having heard it emit modulated sounds. Its flight is generally short and rapid, from the top of one tree to the base of another; but it may sometimes be seen traversing a space of several hundred yards, which it does with a quick and undulatory motion at a considerable elevation."

It is a permanent resident, occurs in all the wooded parts of the country, but is nowhere numerous, and never appears in flocks. In winter it shifts about from place to place, generally accompanying a flock of Tits or Kinglets, but sometimes seeking for its food solitarily, seldom entering small gardens, but often appearing in woods near houses, hedgerows, or even on large single trees. It pairs in April, and about the beginning of May begins to construct its nest, which it places in some hole in a tree, or rock, or among the roots in a mossy bank. It is composed of withered stocks and blades of grasses, moss, fibrous roots, and other materials, and is lined with feathers. The eggs, from five to seven or eight in number, are seven-and-a-half twelfths of an inch in length, five-twelfths in breadth, of a regular oval form, glossy white, sprinkled with dots and small patches of brownish-red, often disposed in a broad belt near the larger end, and leaving the narrower half unspotted. Montague states that "during the time of incubation the female is fed by the other sex, whenever she quits the nest in search of food." The young are abroad by the middle of June, and there is reason to believe that a second brood is frequently reared.

THE FOURTH GROUP OF THE TURDIFORMES—THE CINNYRIMORPHÆ—HONEY-EATERS.

The Honey-eaters are distinguished by their long extensile tongue, which in some of the species is continued backwards under the skin over the head even as far as the eye, in the way which has already been referred to in the Woodpeckers (Vol. III., pp. 334, 335). The bill is in most of the species slender, rather long and curved, and very sharp at the tip, and is more hollowed than is usual in the majority of birds. They have no rictal bristles. The greatest number of the Honey-eaters come from Australia and Oceania, and in Africa and India they are replaced by the Sun-birds. The above groups, in fact, form the only two families into which the Honey-eaters are divisible.

The first family is—

THE MELIPHAGIDÆ, OR TRUE HONEY-EATERS.

In this family the tongue is doubly cleft and pencilled at the tip; the nostrils are long, and shut in with a large horny membrane on the upper edge. The bill is shorter than in the Sun-birds. As mentioned above, the *Meliphagidæ* are entirely confined to Australia and Oceania. Speaking of them in his great work on the "Birds of Australia," Mr. Gould remarks:—"The Honey-eaters, or that group of birds forming the family *Meliphagidæ*, are unquestionably the peculiar and most striking feature in Australian ornithology. They are, in fact, to the fauna what the *Eucalypti*, *Banksiæ*, and *Melaleucæ* are to the flora of Australia. The economy of these birds is so strictly adapted to those trees that the one appears essential to the other; for what can be more plain than that the brush-like tongue is especially formed for gathering the honey from the flower-cups of the *Eucalypti*, or that their

diminutive stomachs are especially formed for this kind of food, and the peculiar insects which constitute a portion of it?"

THE WARTY-FACED HONEY-EATER *Meliphaga phrygia*).

Mr. Gould gives the following account of this species:—"This is not only one of the handsomest of the Honey-eaters, but is also one of the most beautiful birds inhabiting Australia, the strongly-contrasted tints of the black and yellow plumage rendering it a most conspicuous and pleasing object, particularly during flight. It is a stationary species, and enjoys a range extending from South Australia to New South Wales; I also met with it in the interior nearly as far north as the latitude of Moreton Bay. Although it is very generally distributed, its presence appears to be dependent upon the state of the *Eucalypti*, upon whose blossoms it mainly depends for subsistence; it is consequently only to be found in any particular locality during the season that these trees are in blossom. It generally resorts to the loftiest and most fully-flowered tree, where it frequently reigns supreme, buffeting and driving every other bird away from its immediate neighbourhood. It is, in fact, the most pugnacious bird I ever saw, evincing particular hostility to the smaller *Meliphagidæ*, and even to others of its own species that may venture to approach the trees upon which two or three have taken their station. While at Adelaide, in South Australia, I observed two pairs that had possessed themselves of one of the high trees that had been left standing in the middle of the city, which tree, during the whole period of my stay, they kept sole possession of, sallying forth and beating off every bird that came near. I met with it in great abundance among the brushes of New South Wales, and also found it breeding among the low apple-tree flats of the Upper Hunter. I have occasionally seen flocks of from fifty to a hundred in number, passing from tree to tree, as if engaged in a partial migration from one part of the country to another, or in search of a more abundant supply of food.

WATTLED HONEY-EATER. (*After Gould.*)

"The nest, which is usually constructed on the overhanging branch of an *Eucalyptus*, is round, cup-shaped, about five inches in diameter, composed of fine grass, and lined with a little wool and hair. The eggs are two in number, of a deep yellowish-buff, marked all over with indistinct spots and irregular blotches of chestnut-red and dull purplish-grey, particularly at the larger end, where they frequently form a zone: they are eleven lines long by eight lines and a half broad. The stomachs of the specimens I killed and dissected on the Hunter were entirely filled with liquid honey; insects, however, doubtless form a considerable portion of their diet."

The sexes are nearly alike in colouring, but the female is much smaller than the male, and the young are destitute of the warty excrescences on the face, that part being partially clothed with feathers. Head, neck, and upper part of the back, chin, and chest black; scapularies black, broadly margined with yellowish-white; upper tail-coverts like the scapularies; wings black, the coverts margined with yellow; spurious wing yellow; primaries black, with an oblong stripe of yellow occupying the margin of the outer and a portion of the inner web next the quill, which is black; secondaries black, broadly margined on the outer web with yellow; under surface black, with an arrow-shaped

mark of yellowish-white near the extremity of each feather; two centre tail-feathers black, slightly tipped with yellow; the remainder black at the base, and yellow for the remainder of their length, the black decreasing and the yellow increasing as the feathers recede from the two central ones; irides reddish-brown; bill black; feet blackish-brown; warty excrescences, covering the face, dirty yellowish-white.*

THE SECOND FAMILY OF THE HONEY-EATERS—THE SUN-BIRDS (*Nectariniidæ*).

These birds inhabit the whole of Africa, ranging through Palestine to India, and thence through the whole of the Indian and Malayan Islands to Northern Australia, where a single species inhabits the Cape York Peninsula and Northern Queensland. The Sun-birds are divided by Captain G. E. Shelley, our first authority on this family, into two sub-families, which he calls respectively *Nectariniinæ* and *Promeropinæ*. In the former of these is placed the great bulk of the Sun-birds, while two species only represent the long-tailed Sun-birds (*Promerops caffer* and *P. gurneyi*). All the Sun-birds with scarcely an exception are birds of brilliant plumage, glittering with metallic lustre, so that they represent in this respect the resplendent Humming-birds of the New World; nor are they unlike the latter in their habits, hovering before the open flowers and extracting the honey and the small insects which frequent them. Of the habits of Sun-birds one may say, with the familiar maxim, *ex uno disce omnes*; for when once these have been described in the case of a single species, the remarks may be taken as characteristic of the whole family. Mr. J. G. Keulemans, who passed a considerable time in West Africa on Prince's Island (Ilha do Principe) in the Bight of Benin, writes as follows of Hartlaub's Sun-bird (*Cinnyris hartlaubi*):—"It is tolerably abundant throughout the island, with the exception of the dense woods, where it is replaced by *C. obscurus*. It is most common on the plains where bushes and bananas occur; but as Prince's Island is thickly covered with verdure, it would be difficult to say where this Sun-bird is most abundant. It is very plentiful near plantations, usually in small groups of from four to six individuals, in which the males are by far the most numerous. They have no special breeding season, for I have found young birds in every month of the year; but I find in my journal, under date of August 30th, that during that month I procured nineteen males, but not a single female; so I suppose that at that season all the hens were breeding. I collected three nests, all of which were very similar. They are of an oval form, and are suspended from one or more twigs, at an elevation of from four to twelve feet from the ground, and generally well concealed amongst the foliage. They were constructed of the hairy appendages that are found on the bark of palm-trees, rather loosely woven together and lined with the soft filaments of flowers, cotton, and other fine vegetable materials, with the opening on the side most exposed to the light. It appears to me that there is only one young bird in each brood, for I never saw the parents feed more than a single young one. It takes a long time before the latter becomes independent; for I have seen the old birds feeding their offspring after it has been perfectly able to fly, and when it was already beginning to assume its adult male plumage. The song of the male resembles that of our Hedge Sparrow, added to which are some notes similar to those of the Wren; it is, in fact, somewhat between the songs of these two birds, a little fuller and in a lower key, while the call-note is like that of the Redstart. By imitating this note they can be brought very close, and can be easily captured, as they are naturally very tame. They feed chiefly on insects, but will also eat small berries and fruit, and are very partial to sipping the juice emitted by the banana-flower before the fruit has set. I kept many alive, and fed them upon *papaya*, *banana*, and bread soaked in sugar and water, with occasionally Ants' eggs. Two males which I tried to bring to Europe died from cold, after having lived in confinement more than three months. The natives call them 'Siwie-barbeiro,' or 'Siwie boca-longe,' and the Portuguese 'Beshaflore' (flower-kissers)."†

It has been already mentioned that a Sun-bird occurs in Palestine, where there seems to be a certain intrusion, as it were, of the Indian Avifauna into that of the Palæarctic region, for the Indian Fish-Owl (*Ketupa ceylonensis*) was also met with by Canon Tristram during his explorations in that country. Concerning the solitary species of *Cinnyris* known as the Jericho Sun-bird (*C. osea*), the latter gentleman writes an account as follows:—"Most residents in Palestine will tell you of the 'Jericho Humming-bird'—a true Humming-bird—and will not allow you to doubt the fact of its

* Gould: "Handbook to the Birds of Australia," I., p. 528. † Shelley: "Monograph of the Sun-birds," Part X.

existence, as it has been seen by them, and was shot by the son of their friend or neighbour. They are not, however, so far astray as Mr. Gould's Devonshire friend, who held the honour of his country at stake in the maintenance of his assertion that Humming-birds were common there. Then these legends have the highest literary warrant: they are embodied in the journals of Lynch and M. de Saulcy. The gallant commodore (certainly a most truthful narrator, and most trustworthy whenever on subjects within the range of his naval training and experience) saw the beautiful spangled 'Humming-bird,' between the Dead Sea and Kerak. M. de Saulcy, yet more fortunate, not only saw in the Ghor es Safieh, at the south end of the Dead Sea, 'Humming-birds with ruby and emerald frills,' but afterwards obtained one of these wonders of the tropics, which, however, was never preserved, as an indiscriminating Cat carried it off from the dissecting table, where it had been left.

"Our acquaintance with the Sun-bird commenced on the last day of the year at Jericho, when six specimens were obtained, close to our camp at Ain Sultan, the day after our arrival. The oases of the plains of Jericho appear to be its metropolis, and we never met with it excepting in the immediate neighbourhood of water. But wherever a few tamarisks, zizyphus-bushes, or graceful 'retem' shade a fountain or straggling pool in some deep glen opening on the Dead Sea, there a few occur. The larger oases, however, of Jericho at the north-west, and Safieh at the south-east end of the Dead Sea, are the resorts of great numbers, which, though here to be found in almost every tree, are nowhere gregarious, but are noisy and pugnacious, the males chasing each other with loud cries, and as tenacious of their respective freeholds as Robins at home. The note is clear and monotonous, very much like the call of the Willow Wren, but sharper, and often reminding one of the Blue Tit, yet with a more hissing sound. This is incessantly repeated from sunrise to evening, and the whereabouts of the male bird can at once be detected; but to see him is not so easy, as he ceaselessly hops in the centre of the very thickest and most impenetrable scrub, and darts very quickly and suddenly across the open from tree to tree. The male is extremely restless, and as it twists and clings to one twig after another, in search of insects, reminds one of the Titmouse much more than of the Creeper in its actions. It has a curious jerking flap of the wings, opening and shutting them like the Wall Creeper (*Tichodroma muraria*). Occasionally I have seen two rivals for the favours of a female singing on the top of a tree, and puffing out the brilliant orange and red axillary tufts, which only at such times are at all conspicuous. The female during the winter continually repeats the same monotonous note, but almost always remains stationary, or creeping slowly about in the very centre of a bush. One female had her quarters in a dense zizyphus-tree fifty yards from our tent, and was used as a decoy-bird by one of our party, who used to go and sit under the tree every morning for a fortnight, and would bring back two or three males, allured to their destruction by this fatal siren, who never left her retreat at the report of the piece. Alas for humanity! on the morning of our departure her good service to this treacherous collector was rewarded by her own death, to be embalmed alongside of her many deceived admirers. . . . . A few days after our visit to Carmel we again met with the Sun-bird in a deep gorge, the Wady Hamam, opening on to the plain of Gennesareth. Mr.

JERICHO SUN-BIRD. (*After Wolf.*)

Cochrane and I pursued it in vain; but while searching among the cliffs for Vultures' nests, Mr. Cochrane pulled down from the extremity of the twig of a hyssop plant what he imagined to be an old nest of a Grass Warbler (*Drymoica gracilis*). It had the external appearance of a loose ball of rubbish, such as might have been floated down by a sudden flood and caught in the branch of a tree. After tossing it about for some time he threw it towards me, and on examining it I was dismayed to find it a fresh nest, very firm and compact inside, with a small hole in the side, and containing two broken fresh eggs, elongated, of a greenish-white, with a zone of darker green-grey spots near the larger end. We searched in vain for another, and mourning our ill-luck, left the neighbourhood the next day. On the 23rd of May I returned to the same place, and while climbing up to a cave, the resort of the Rufous Swallow (*Hirundo rufula*), I struck with my head a little ball of straw and leaves attached to the extremity of a castor-oil plant, not two yards from the spot where Mr. Cochrane had found his nest. It contained three eggs, quite fresh, and was beautifully shaded both from the sun and from observation. I was fortunate enough to secure the male bird in full plumage. Close by was another nest, from which one young bird had been reared; and we watched the female feeding her young family of three in the hyssop overhead. I am inclined to believe that they had bred twice, for we could not make out a third pair. Meanwhile, I had returned in April to our old quarters at Ain Sultan, near Jericho, accompanied only by a single muleteer and one guard. On the afternoon of my arrival, on the 13th of April, I discovered by myself no less than seven nests—one with three eggs, one with two hard set, one building, and four with young. All were in precisely similar situations, suspended from the extremity of a small twig hanging down in the centre of a 'nubk' tree, whose thorny branches spread in a circle so close to the ground that I had in every instance to creep on all-fours till I could get under the trees. The nests in these places were perfectly inaccessible to the attacks of the serpents and lizards which abound there. The nests are at first very neat and compact, long straws and fibres being attached to the extremity of the drooping bough, and on these the bag is woven. When finished, a few loose leaves and straggling straws are loosely fastened all round, to elude observation and remove the appearance of art. I kept three young birds for ten days in a box, and fed them with bunches of the blossom of a jasmine and convolvulus. The hen bird lingered always in the neighbourhood of the tent, doubtless attracted by their cries; and when we were about to leave I turned out the two surviving captives, and was glad to see the parent take to them at once, and attend to them in an adjoining tree."*

WING OF PIPIT, SHOWING THE LONG SECONDARIES.

THE SECOND SUB-ORDER OF THE PASSERIFORMES. THE FRINGILLIFORMES, FINCH-LIKE BIRDS.

All the members of the Fringilliform group of perching birds have only nine primary quills, the first being very long, as may be seen in the subjoined sketch of a Pipit's wing. The families which make up this sub-order are seven in number, and it is difficult to arrange them in any successive order, for they are all more or less closely related to other forms which are placed in one or other of the remaining orders of the Passeriformes. Thus the Wagtails and Pipits (*Motacillidæ*) are nearly allied to the Larks (*Alaudidæ*), the American Warblers (*Mniotiltidæ*) to the true Warblers (*Sylviidæ*), the American Creepers (*Cœrebidæ*) to the true Creepers, or *Certhiomorphæ*, the Flower-peckers (*Dicæidæ*) to the Sun-birds (*Cinnyrimorphæ*), the Swallows (*Hirundinidæ*) to the Flycatchers (*Muscicapidæ*), the Finches (*Fringillidæ*) to the Weaver-birds (*Ploceidæ*), and the Hang-nests (*Icteridæ*) to the Starlings (*Sturnidæ*). As it is obvious that all these relationships cannot be shown in a linear arrangement, each family will have to be considered separately, and its relations explained as the work progresses. In fact, it is impossible in any way to arrange the families of birds in a straight line, any more than one can range the countries of Europe in direct succession, a fresh start having to be made every now and then.

* "Ibis," 1865, p. 72.

THE FIRST FAMILY OF THE FINCH-LIKE BIRDS.—THE MOTACILLIDÆ. WAGTAILS AND PIPITS.

These birds can always be recognised by a striking peculiarity of the wing, which, in addition to their habits and general economy, proclaims at a glance their Lark-like affinity. In the Wagtails and Pipits the innermost secondaries are of extreme length, nearly equalling the long primaries. This is a feature which is very pronounced in all Larks, like which birds, also, the Wagtails and Pipits seek their food on the ground, have large feet in proportion to their size, and progress by walking instead of by hops. Some of the Pipits, too, have the habit of mounting into the air and uttering their song, much the same as a Woodlark would do, though not to the same extent as a Skylark. The eggs of the Pipits likewise resemble to a great extent those of a Lark.

The Wagtails may be recognised from the Pipits by their longer tail, which exceeds the wing in length, whereas in the last-named group of birds the wing is either equal to the tail or exceeds it in dimensions. They may be divided naturally into two groups, called the Pied or *Water* Wagtails (*Motacilla*), and the *Field* Wagtails (*Budytes*). As a rule, the prevailing colours in the latter group are grey and yellow, and they have rather shorter tails, but it is doubtful whether more than one genus of Wagtails can properly be recognised, for there is an intermediate form, the Grey Wagtail (*Motacilla melanope*), which combines the habits and form of an ordinary Water Wagtail with the grey and yellow coloration of a Field Wagtail.

THE PIED WAGTAIL (*Motacilla lugubris*).

This is one of the peculiarly English birds, being one of the few European species which are common in the British Islands and rare in other parts of the Continent; this, at least, is true as regards the breeding season. In the south of England it is a resident bird, though the numbers decrease in very severe weather, when the bird probably migrates, for in Western Scotland it may be looked upon as a regular migratory species, as it has been stated to disappear entirely from its summer haunts in the outer Hebrides, where it returns again in spring. It was at one time supposed to be only a native of Great Britain, and is even to this day best known by the name of *Motacilla yarrelli*, having been thus called by Mr. Gould, after the celebrated English naturalist Yarrell. In the part of Berkshire near Cookham, where many of the writer's personal experiences of birds have been gathered, the Wagtail is the especial victim of the Cuckoo, many of whose eggs he has found in the nest of the Pied "Dishwasher," as he is familiarly called in that and in most parts of the country. On one occasion the nest was built in the mould of a flower-basket on the lawn at Formosa, near Cookham, and at some distance from the edge of the wood-work. There the nest was found by Mr. Briggs, the head-gardener on the estate, one of the best field-naturalists known to the writer, as indeed is testified by the frequent references to his observations in Mr. Gould's "Birds of Great Britain," and to this day his untimely death is deplored by all who knew him. The Cuckoo's egg was duly pointed out by Mr. Briggs, but so exactly alike in colour was it to the other eggs of the foster-parent, that the writer expressed the strongest doubts as to its being really anything but a rather large Wagtail's egg. Time, however, proved the contrary, and it was not long before the nest, which was rather a rudely constructed affair, placed in a hollow depression in the mould of the flower-basket, was completely filled by a hungry, yellow, gaping, young Cuckoo, who, on being hatched, disposed in the usual cuculine way of his foster-brothers and sisters. These were found, curiously enough, lying dead on the grass at some little distance from the flower-basket, and the question which was asked was, whether the old Cuckoo really is the unregenerate deserter of its offspring that it is generally made out to be, or whether it still takes a parental interest in the young birds, which it nevertheless leaves to the care of foster-parents to bring up. Mr. Briggs always held the idea that the Cuckoo was not devoid of this natural instinct, and he imagined that the removal of the young Wagtails was the work of one of the parents of the young Cuckoo. It is, however, probable that the old Wagtails, finding the dead bodies of the nestlings left on the mould, themselves acted as undertakers, and carried them to some little distance. All the time that the nest was under examination the Wagtails were in close attendance, with their mouths full of caterpillars and insects, evincing the utmost distress, and running about on the edge of the flower-basket. Mr. Gould even

says that they will fly in the face of any one attempting to remove their unwieldy foster-child, and that when the latter is restored to the nest they "will evince their joy by fondling and dancing around it, leaping over its back, and exhibiting many other demonstrations of delight."

The following excellent description of the Wagtail's habits is given by Macgillivray :—

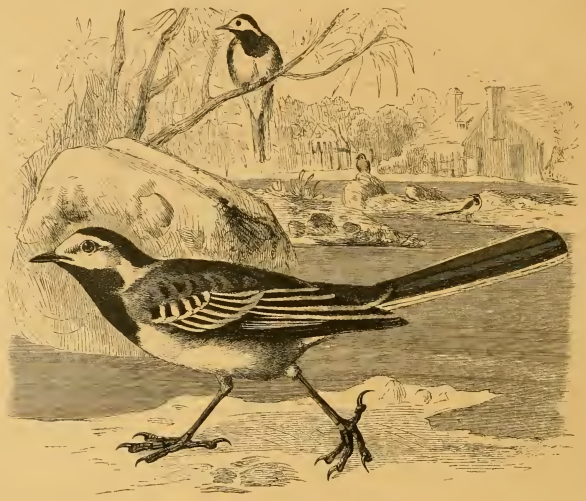
"The places usually frequented by this beautiful bird are the margins of streams, ditches, pools, and lakes. Towards the end of July, when the cares of rearing their young are over, they betake themselves in great numbers to the mouths of rivers, especially such as have marshy meadows along their sides, or muddy expanses to which the tides have access. Often one may see them wading in shallow places in quest of insects and worms, carefully holding up their tail to prevent its being draggled. If you watch the motions of an individual just coming up to join the party, you see it alight abruptly, twittering its shrill notes, and perching on a small stone, incessantly vibrate its body and jerk out its tail. It now perhaps walks out into the water and searches for food, or, finding none, flies to the shore, and runs along with great rapidity, stopping and stooping now and then to pick up a tiny wormlet, and momentarily spreading out its ever-vibrating tail. Its light footsteps leave no impression on the soft sand, and if it walks out upon the mud you wonder that its little toes do not get clogged; yet so rapid are its motions that it never sinks in the mire, and when the latter becomes too soft it aids itself with its wings or flies to a place where it may find more secure footing. Now it runs into the meadow, in pursuit of a fly, which it has no sooner caught than it spies another. The lazy geese that have nibbled the grass bare allow it to pass in the midst of them without molestation, or if some malicious gander or foolish gosling attempts to seize it, they find that they have given themselves too much credit for dexterity. There the cows are grazing in the midst of a swarm of gnats and other insects, and the Wagtail has arrived in their vicinity. Running forward, it catches a small fly, bends to one side to seize another, darts to the right after a third, and springs some feet into the air before it secures a fourth. Now see it picking among the old dung, where there are doubtless many larvæ concealed, again running off in pursuit of a fly, passing close to the cow's nose or among her feet. There, while in pursuit, it encounters another of its own species; but they quarrel not, no doubt aware that there is room enough for both of them in the world, or even in the meadow, which you now see to be covered with Wagtails, all busily occupied, some walking, others running, a few flying off, and many arriving. You may walk in among them: they are not very shy, for they will allow you to come within fifteen yards, or sometimes less; and you may shoot as many as you please, for although some will fly off, others will remain, and of the former a few will settle in the neighbourhood. Day after day you will find them here when the tide is out. At other times you may search for them by the edges of the river, along the mill-dam, in the meadows, or even in the dry pastures. Occasionally you may see them perched on a roof, a wall, or a large stone, but very rarely on a tree or bush. Towards the middle of October many of them take their departure from the middle and southern parts of Scotland, and the rest wander over the country, frequenting watery places, and in hard weather approaching houses, searching the sides of the roads, the dunghills, and even the cottage doors. In most parts of the south of Scotland they are not at all uncommon in winter, but in England they are much more abundant.

"About the beginning of March the migratory movement commences. Many remain in the south, but many also move northward, and some arrive in the northernmost parts of Scotland and in the outer Hebrides by the middle of March. It is a pleasant sight to see a small group of these birds walking and running with light and graceful steps along the newly-turned furrows on a cold, dry morning in spring, when the east wind nips your fingers and calls the blood into your cheeks. Rooks are scattered over the field; a few Hooded Crows are searching the distant end of the ridge, but they have little dread of the ploughman, follow close upon his heels, or merely rise before the horses, to resume their station when they have passed. At this season they obtain an abundant supply of food, and as the labouring lasts until the warm weather sets in, they need never suffer for lack of larvæ or insects. But at all seasons they are fond of rambling along the shores of the sea, and especially of estuaries, lakes, and rivers.

"About the middle of April, when they have paired and scattered over the country, they begin their preparations for the more important business of the season. Their nests are placed by the side of a river or stream, on a rocky bank, or among the grass, or on a heap of stones, or in a hole in a

wall, and are composed of stems and leaves of withered grasses, mixed with some moss and leaves, and thickly lined with wool and hair, sometimes also with feathers. One now before me is of a somewhat flattened form, rather bulky and rudely constructed, its external diameter five inches, the internal three and a half. The outer layer is composed of fibrous roots, stems and blades of grasses, intermixed with hair. The inner is a rude mass of hair of various kinds in tufts: human hair, black, brown, red, and sand-coloured; hair of dogs, cats, cows, and horses; hog's bristles, and some cotton, thread, and feathers. The eggs, five or six in number, are greyish-white, spotted all over with grey and brown, their average length nine-twelfths of an inch, their greatest breadth seven and a quarter twelfths.

"The ordinary note of this species is a sharp chirp. When alarmed or otherwise agitated, it flies



WHITE WAGTAIL.

about in a wavering manner, uttering a repetition of this note, and alarming the small birds in the neighbourhood. In sunny weather, especially in the mornings, it may be heard singing a pleasant, mellow, and modulated little song. The flight is light, buoyant, and undulated; it propels itself by a repetition of smart flaps, ascends in a curved line, then ceases for a moment, descends in a curve, repeats the motion of its wings, and thus proceeds, as if by starts, and with great velocity. Like many other birds, it is not fond of flying down the wind, but prefers an oblique course. In its habits it is quite terrestrial; at least, I have never seen it search for food on trees, bushes, or even herbaceous plants, although it not unfrequently perches on a hedge or bush during the breeding season. It is curious to observe this species pursuing its prey in different localities. Thus, if you watch it for some time when it has taken its station among stones or fragments of rock, you cannot fail to be pleased with the activity and dexterity which it displays. There it stands on the top of a stone, gently vibrating its tail, as if poising itself. An insect flies near, when it starts off, flutters a moment in the air, seizes its prey, and settles on another stone, spreading and vibrating its tail. Presently it makes another sally, flutters about for awhile, seizes two or three insects, glides over the ground, curving to either side, and

again takes its stand on a pinnacle. Again, you perceive several Wagtails flying in a wavering and buoyant manner over the rushes that skirt a large pool. It is a calm bright evening, the Coots are swimming about among the reeds and horsetails, uttering now and then their short, loud, trumpet-like cry, and the White-rumped Swallows are glancing along, now dipping lightly into the water to seize a fly, then darting here and there amongst the tiny insects that sport over the rank weeds. A Wagtail tries an excursion over the water, and although its flight does not equal that of the Swallow in elegance and velocity, it yet performs its task with considerable grace, flutters here awhile, seizing a few insects, sweeps away in a curve, as if to acquire sufficient speed to keep it up without fluttering, turns suddenly, then shoots forth in a straight line, and thus continues for several minutes, until at length, fatigued, it betakes itself to the top of the stone wall, where it rests a little, and then commences a new excursion. Not unfrequently it may be seen running along the roof of a house in search of insects, which it seizes in the manner of the Flycatcher or Redstart. Often also it is to be found among rocks, and it is not uncommon in the streets of country villages, where it searches for insects, chiefly along the gutters."

Under the heading of a "Season Ticket," the following story went the round of the papers in the summer of 1878:—"It may be interesting to some of your readers to be informed that on a small piece of framework underneath a third-class smoking carriage on the London and South Western Railway, a Water Wagtail has built her nest and reared a young and thriving family of four. The train runs regularly from Cosham to Havant five times a day, in all about forty miles; and the station-master informs me that during the absence of the train the male bird keeps close to the spot, waiting with manifest interest and anxiety the return of his family from their periodical tours."

THE SECOND FAMILY OF THE FINCH-LIKE BIRDS.—THE CÆREBIDÆ.

AMERICAN CREEPERS.

There is a great difference in the outward aspect of the American Creepers and the true Creepers of the Old World, which have spiny tails; the former rather approach the Nuthatches, like which birds, most of them have soft-feathered, squared tails. In fact, in Southern and Central America there is a genus *Diglossa*, which is wonderfully like *Sitta* in appearance, but with a hooked and rather upturned bill. To the present family belong also the pretty little Blue Creepers, which are so often mounted in glass shades, and seen, alas! on hundreds of ladies' bonnets, and which are remarkable for their vivid blue colour and yellow-spotted wings. Another interesting group is seen in the genus *Certhiola*, the members of which are principally Central American, though some species extend southwards as far as Brazil.

THE BANANA QUIT (*Certhiola flaveola*).

For the habits of this interesting little bird, a reference must be made to the well-known work of Mr. Gosse on the "Birds of Jamaica."* "Scarcely larger than the average size of the Humming-birds, this little Creeper is often seen in company with them, probing the same flowers and for the same purpose, but in a very different manner. Instead of hovering in front of each blossom, a task to which his short wings would be utterly incompetent, the Quit alights on the tree, and proceeds in the most business-like manner to peep into the flowers, hopping actively from twig to twig, and throwing the body into all positions, often clinging by the feet, with the back downwards, the better to reach the interior of a blossom with his curved beak and pencilled tongue. The minute insects which are always found in the interior of flowers are the objects of his search and the reward of his perseverance. Unsuspectingly familiar, these birds often resort to the blossoming shrubs of gardens and yards. A large moringa tree, that is all through the year profusely set with fragrant spikes of bloom, is a favourite resort both of these and the Humming-birds. One within a few feet of my window is, while I write this note, being carefully scrutinised by two active little creatures that pursue their examination with a zeal perfectly undisturbed by my looking on, while the same blossoms are rifled on one side by a

* "Birds of Jamaica," p. 84.

minute Humming-bird, and on the other by that gorgeous Butterfly, *Urania sloaneus*—an interesting association. The Quit often utters a soft, sibilant note as it peeps about.

"The nest of this bird is very frequently, perhaps usually, built in those low trees and bushes from whose twigs depend the paper nests of the brown wasps, and in close contiguity with them. The Grass Quits are said to manifest the same predilection; it is a singular exercise of instinct, almost of reason, for the object is doubtless the defence afforded by the presence of the formidable insects, but upon what terms the league of amity is contracted between the neighbours I am ignorant.

"It is in the months of May, June, and July that the Creeper performs the business of incubation. On the 4th of May I observed a Banana Quit with a bit of silk cotton in her beak, and on searching, found a nest just commenced in a sage-bush (*Lantana camara*). The structure, though but a skeleton, was evidently about to be a dome, and so far was constructed of silk cotton. Since then I have seen several completed nests. One now before me is in the form of a globe, with a small opening below the side. The walls are very thick, composed of dry grass, intermixed irregularly with the down of asclepias. It appeared to have been forsaken, from my having paid it too much attention. It was fixed between the twigs of a branch of a bauhinia, that projected over the high road near Content, in St. Elizabeth's. Another, which I found at the end of June in a sage bush, was of the same structure; in this were two eggs, greenish-white, thickly but indefinitely dashed with reddish at the larger end."

THE THIRD FAMILY OF THE FINCH-LIKE BIRDS.—THE MNIOTILTIDÆ. AMERICAN WARBLERS.

The American Warblers are similar in form and also in habits to the Warblers of the Old World, but, as already stated, they have no "first" or "bastard" primary, as it is called, so that they must be placed in quite a separate sub-order of the Perching Birds. They are of a more vivid coloration than their more sober-plumaged Old World cousins, many of them having a beautiful admixture of yellow, black, chestnut, and white in their plumage. Many of them are closely allied to some of the American Creepers (*Certhiidæ*), but are distinguished by a shallow notch at the end of the tongue, instead of the deeply-fissured tip which is the characteristic of members of the last-mentioned family.* Some of the American Warblers are extremely rare, and appear to be local in their distribution; they seem, however, to be nearly all migratory, many of them spreading over a wide extent of North America during the summer, and taking up winter quarters in Central America, some even extending to South America.

THE SUMMER YELLOW BIRD (*Dendroica æstiva*).

Dr. Brewer writes:—"The Summer Yellow Bird arrives in New England with great uniformity from the 1st to the middle of May. Its coming is usually the harbinger of the opening summer and expanding leaves. Unlike most of its family, it is confiding and familiar, easily encouraged, by attention to its wants, to cultivate the society of man. It confidingly builds its nest in gardens, often in close vicinity to dwellings, and in the midst of large villages and cities, among the shrubbery of frequented parks. This Warbler, soon after its arrival, begins the construction of its nest. It is usually placed in low bushes, three or four feet from the ground. Occasionally very different positions are chosen. Hedges of buckthorn and hawthorn, barberry-bushes, and other low shrubs are the favourite places of resort. On one occasion the nest was placed some forty feet from the ground in the top of a horse-chestnut tree overhanging the main street of a village. Such high positions are, however, not very common. The nest is invariably fastened to several twigs with great firmness, and with remarkable neatness and skill. A great variety of materials is employed in the construction of their nests, though not often in the same nest, which is usually quite homogeneous. The more common materials are the hempen fibres of plants, fibrous strips of bark, slender stems of plants and leaves, and down of asclepias. Interwoven with these, forming the inner materials, are the down from willow catkin, the woolly furze from fern stalks and the *Eriophorum virginicum*, and similar substances. These are lined with soft, fine grasses, hair, feathers, and other warm materials. Cotton, when procurable, is a favourite material, so also is

* Baird, Brewer, and Ridgway: "North American Birds," Vol. I., p. 177.

wool; where abundant, I have known instances where nests were built almost exclusively of one or the other material. A pair of these birds, in 1836, built their nest under a parlour window in Roxbury, where all their operations could be closely watched. When discovered, only the framework, the fastening to the supporting twigs, had been erected. The work of completion was simple and rapid. The female was the chief builder, taking her position in the centre of the nest and arranging the materials in their places as her mate brought them to her. Occasionally, with outstretched wings and expanded tail, she would whirl herself round, giving to the soft and yielding materials their hemispherical form. At intervals she arrested her revolutions to stop and regulate with her bill some unyielding portion. When her mate was dilatory, she made brief excursions and collected materials for herself, and when the materials brought her were deemed unsuitable they were rejected in a most summary and amusing manner. The important part of the tail-feathers in shaping the nest and placing the materials in position was a striking feature in this interesting performance. The greater portion of the nest was thus constructed in a single day. The wonderful sagacity displayed by this Warbler in avoiding the disagreeable alternative of either having to abandon its own nest or of rearing the young of the intrusive Cow Blackbird, when one of these eggs is dropped into her nest, was first noticed by Mr. Nuttall. The egg of the parasite, being too large for ejectment, is ingeniously incarcerated in the bottom of the nest, and a new lining built over it. Occasionally, either by accident or design, the intrusive egg has been fractured. Mr. Nuttall states that when the parasitic egg is laid after her own, the Summer Yellow Bird utterly refuses to act the part of a foster-parent, and rather than do so sacrifices her own eggs. So far as I know, this Warbler will never sit upon or hatch out the egg of the Cow-bird under any circumstances. Some powerful instinct, bordering closely upon reason, seems to teach these intelligent Warblers the character of the intruder, and they sacrifice their own eggs rather than rear the parasite. In this dilemma they will always, so far as I know, incarcerate their own eggs with the Cow-bird's, and re-construct the nest above them. In one instance, the same pair of Yellow Birds, twice in the same nest, covered up alien eggs in this manner, building, in fact, three nests one above the other, between the walls of which had been successfully included two eggs of the Cow-bird. This three-storeyed nest measured seven inches in length, and was built almost exclusively of raw cotton. The covering of the imprisoned eggs was about two-thirds of an inch thick. In both instances the Cow-bird's eggs had been broken, apparently by design. So far as I am aware, this Warbler raises but one brood in Massachusetts in a season. In Pennsylvania it is said to raise two, and even three. The eggs are usually five and occasionally six in number. This Warbler is conspicuous in its devotion to its young, evincing a strong attachment and an anxiety even in regard to an occupied nest, and betraying the site by this solicitude. They will also resort to various expedients to draw one away from their nest by feigned lameness and other stratagems and manœuvres.

"The song of the Summer Yellow Bird is simple but pleasing, and is easily recognised when once known, though liable to be confounded with that of the Maryland Yellow Throat, and also said to resemble the song of several other Warblers.

"In confinement they usually become very tame, confiding, and reconciled to their imprisonment, and have been known to perch on an outstretched finger and to catch flies in a room. Their eggs vary in length from ·61 to ·70 of an inch, and in breadth from ·49 to ·52. They have a ground-colour of a light green. Their dots and blotches vary greatly in number, size, and manner of distribution. Their colours are light purple, darker purplish-brown, and other shades of brown and lilac."

CHAPTER V.

THE FLOWER-PECKERS—THE CHATTERERS—THE SWALLOWS—THE TANAGERS—THE TRUE FINCHES—THE HANG-NESTS.

THE FLOWER-PECKERS—The Bornean Species—THE AUSTRALIAN FLOWER-PECKER—THE CHATTERERS—Characters—THE BOHEMIAN WAXWING, OR WAXEN CHATTERER—Superstitions regarding it—Professor Newton's Account of Mr Wolley's Discovery of its Nest and Eggs—Description of the Bird—THE SWALLOWS—Professor Garrod's Explanation of the grounds for placing Swallows and Swifts in Separate Orders—THE ROUGH-WINGED SWALLOWS—THE SMOOTH-WINGED SWALLOWS—The Three English Species—THE COMMON SWALLOW—Harbinger of Summer—Buffon's Anecdote—Migrant—Usefulness—Nest—THE TANAGERS—Insect Eaters—Brilliant Plumage—Species—THE SCARLET TANAGER—Dr. Brewer's Account of its Habits—THE TRUE FINCHES—The Two Sections—Palate Characters—Nest of Chaffinch—Nesting of Bullfinch—Palate and Bill Characters in Buntings—THE CROSSBILLS—Habits—Curiously-formed Bills—Longfellow's "Legend of the Crossbill"—THE HANG-NESTS—The Three Sub-Families—Habits of the Cow-bird—THE BALTIMORE ORIOLE—Dr. Brewer's Description of its Habits—THE BOAT-TAIL.

THE FOURTH FAMILY OF FINCH-LIKE BIRDS.—THE DICÆIDÆ—FLOWER-PECKERS.

THESE beautiful little birds, of which a large number are known, are almost exclusively Indian and Australian, only two species being found in Africa, where they are confined to the forest region of the west coast; these are *Pholidornis rushiæ* and *P. rubrifrons*. Their habits are described as being very similar to those of the English Titmice and Gold-crests. They build very beautiful nests, like a purse. Mr. Motley thus describes the Bornean species, the Black-chinned Flower-pecker (*D. nigrimentum*)*:—

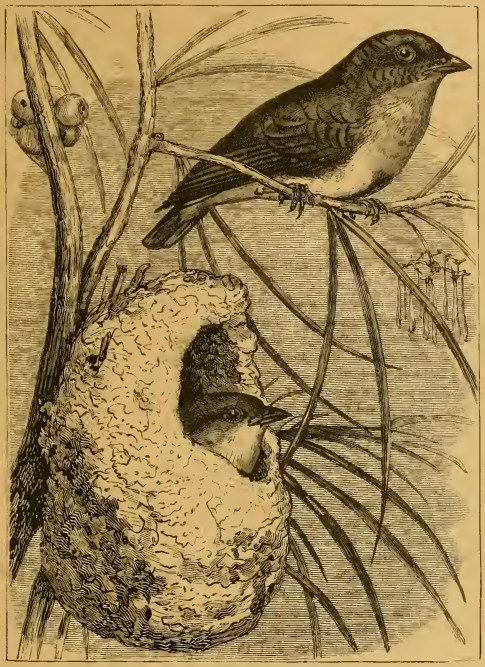
"These little birds are not uncommon in Labuan, and have something of the habits of the English Regulus; they haunt low brushwood, and continually utter a low, shrill chirp. They are very fearless, allowing themselves to be almost touched before they take to flight. The Malay name, which signifies Spark Bird, is very appropriate, as, when darting about among the bushes, the cock bird really looks as bright as a flash of fire. The nest of this species is about the shape and size of a goose's egg, and is suspended by the small end from some slender twig of a tall tree. It is built of fine green moss and a sort of brown byssus, and lined with some white fibre and a few small feathers. One of these nests was found on a tree which was felled in the jungle, and all the young birds, however, except one, had been killed by the fall. The survivor was brought to Mrs. Motley, who succeeded by great care in bringing it up, feeding it at first upon rice and banana pulp. As soon as it was strong enough it was placed in a small cage. Though very restless, never being for one moment still, it was perfectly tame and fearless, and would sit upon the finger without attempting to fly away; and though its whole body, feathers and all, might have been shut up in a walnut, it would peck at a finger held towards it with great fierceness. For a long time it would only take food from the hand, but afterwards, when food was given it, it dropped, and shook its wings rapidly, as we see a hen Partridge occasionally do. At first its beak was short, straight, and sharp, but as it grew its form gradually changed to that of the adult Dicæums; it also changed its diet altogether, refusing rice, and only occasionally taking plantain. For some weeks it fed exclusively upon sugar and water, which it sucked up like a Hummingbird. It was very fond of bathing in a large shell full of water placed in its cage."

THE AUSTRALIAN FLOWER-PECKER (*D. hirundinaceum*).

Mr. Gould writes†:—"By far the greater number of the Australians are, I believe, unacquainted with this beautiful little bird, yet there is scarcely an estate in either of the colonies in which it may not be found, either as a permanent resident or an occasional visitor. Its natural disposition, leading it to confine itself almost exclusively to the topmost branches of the loftiest trees, is doubtless the cause of its not being more generally known than it is, its rich scarlet breast not even attracting notice at the distance from the ground at which it generally keeps; and in obtaining specimens I was more frequently made aware of its presence by its pretty warbling song than by its movements among the branches: so small an object, in fact, is most difficult of detection among the thick foliage of the lofty *Casuarinæ*, to which trees it is extremely partial,

* Motley and Dillwyn: "Nat. Hist. Labuan," p. 18. † "Handbook to the Birds of Australia," Vol. I., p. 581.

particularly to those growing on the banks of creeks and rivers. It is also frequently to be seen among the clusters of the beautiful parasitic Coranthus, which is very common on the *Casuarina* in the neighbourhood of the Upper Hunter. Whether the bird is attracted to this mistletoe-like plant for the purpose of feeding upon its sweet and juicy berries I could not ascertain; its chief



AUSTRALIAN FLOWER-PECKER, OR SWALLOW DICÆUM. (*After Gould.*)

food is insects, but in all probability it may occasionally vary its food. The Swallow Dicæum has neither the actions of the Pardalotes nor of the Honey-eaters; it differs from the former in its quick, daring flight, and from the latter in its less prying, clinging, and creeping actions among the leaves, &c. When perched on a branch it sits more upright, and is more Swallow-like in its contour than either of the forms alluded to; the structure of its nest and the mode of its nidification are also very dissimilar.

"Its song is a very animated and long-continued strain, but is uttered so inwardly that it is almost necessary to stand beneath the tree upon which the bird is perched before its notes can be heard.

"It would appear that the range of this species extends to all parts of the Australian continent, since I have received specimens from every locality yet explored. I found it breeding in the Lower Namoi, which proves that the interior of the country is inhabited by it as well as those portions between the ranges and the coast."

Mr. White, of the Reed Beds, near Adelaide, says:—"This little bird is sometimes rather numerous here. It appears to be wholly frugivorous, for all of those I have dissected had fruit in them. It has no regular stomach, not even an enlargement of the intestine, which averages about five inches and a half in length, and through which the food passes whole. It arrives at Adelaide about February, and stays but a short time. I have met with it very far north."

Its beautiful purse-like nest is composed of the white cotton-like substance found in the seed-vessels of many plants, and among other trees is sometimes suspended on a small branch of *Casuarina* or an *Acacia pendula*. The ground-colour of the eggs is dull white, with very minute spots of brown scattered over the surface; they are nine lines long by five lines and a half broad.

The male has the head, all the upper surface, wings, and tail black, glossed with steel-blue; primaries black; throat, breast, and under tail-coverts scarlet; flanks dusky; abdomen white, with a broad patch of black down the centre; irides dark brown; bill blackish-brown; feet dark brown. The female is dull black above, glossed with steel-blue on the wings and tail; throat and centre of the abdomen buff; flanks light brown; under tail-coverts pale scarlet.

THE FIFTH FAMILY OF THE FINCH-LIKE PERCHING BIRDS.—THE AMPELIDÆ. CHATTERERS.

The true Chatterers are a small group of birds, of which the Bohemian Waxwing and the Cedar Bird of America are the familiar examples. Some naturalists place along with these birds, the sole representatives of the genus *Ampelis*, a few Central American genera, which probably belong to the family, but are not *Wax*-wings. The characters which distinguish the *Ampelidæ* are a short and rather stout bill, a little widened, with a nearly obsolete hook, and faint indications of an incision near the tip of the bill; the plumage is very soft and silky; the wing is long, but the tarsus is very short. Even admitting the five supposed Central American species of Central American Chatterers, the whole family contains only eight species, of which two are confined to the Palæarctic region, the best known being—

THE BOHEMIAN WAXWING, OR WAXEN CHATTERER (*Ampelis garrulus*).

This bird gains its name of Waxwing from the beautiful ornamentation which appears on the secondary quills, and there takes the form of an elongated drip of sealing-wax, which is also occasionally, but more rarely, developed on the tail-feathers. The home of the Waxwing extends throughout the northern parts of Europe, Asia, and North America, and a considerable migration takes place in winter, sometimes in such numbers that the bird is supposed in some of the countries of Central Europe to be the precursor of famine or pestilence, and this circumstance has gained for it in Holland the name of *Pestvogel*. It is difficult, at a distance of many years, to imagine the excitement which existed in former days amongst zoologists concerning the nest of the Waxwing, and the first authentic record that was published of the breeding of this bird was an account of the researches of the late Mr. John Wolley, to whose indefatigable zeal the world is indebted for positive information of the nidification of a great number of the rarer European birds. Professor Newton* has told the story of Mr. Wolley's success in finding the Waxwing's nest. "It is unnecessary to repeat here the fabulous accounts given by former writers respecting the nidification of this bird. The very plain statement communicated by Mr. Wolley to the Zoological Society on the evening of the 24th of March, 1857, is sufficient to set them at rest for ever. But still I may remark that from the days of Linnæus (who said of it, '*Nidus in rupium antris*') downwards, nearly all the conjectures published seem to have been wide of the mark. In years gone by, one of the hardiest of our Arctic explorers, Sir John Richardson, had failed to ascertain anything connected with its breeding in the far countries of the north-west; and, more recently, the intrepid Siberian traveller, Dr. A. Von Middendorf, was unsuccessful in the north-east. Yet it may be safely said that there was no bird whose egg was so

* "Ibis" for 1861, p. 93.

longed for by the ornithologists of the whole world. Various were the plans they bethought them of for attaining this *desideratissimum*. Many tried to keep pairs of living birds, in the hope of inducing them to breed in confinement. One enthusiastic egg-collector, Baron R. Von König-Warthausen, we are told, even went to the trouble of caging a whole flock. It is true that here and there an oologist might be found with whom the 'wish was father to the thought,' and who accordingly deluded himself into the belief that in some unusually large specimen of the egg of the allied species (*Ampelis cedrorum*), or in some queerly-coloured monstrosity of a bird, perhaps not at all connected, he recognised a genuine production of *Ampelis garrulus*; but such instances were certainly exceptional, and there can be little doubt that prior to 1856 no one with any pretension to the title of naturalist had ever set eyes on a real egg or nest of the Waxwing, and that this privilege was reserved for one who of all men eminently merited it. It is due, however, to Scandinavian naturalists to say that several of them who had travelled in Lapland had expressed themselves confident that the bird did sometimes breed in that country; and though the reports of its nesting which some of them brought home have been shown by Mr. Wolley's discovery to be probably incorrect, yet it was, I think, reliance on the general fidelity of those gentlemen in matters of this kind which kept alive my friend's hopes of one day finding the long-sought treasure: but hopes they were of a kind so remote, that when they were fulfilled he was justified in speaking of the discovery as 'unexpected.'

"The first intimation I received from Mr. Wolley that the discovery was accomplished was contained in a letter written by him on his way up the Baltic, and dated 2nd September, 1856. He says:—'Let me tell you now, whilst I think of it, that I have some reason for believing that the Waxwing makes its nest in good-sized fir-trees in the month of June. I give you this hint in case I should not live to give you more certain information; but you remember that I am not to return home without a Waxwing's nest in my hand.' He had, in fact, a few days before, when at Stockholm, received from his faithful Ludwig a letter telling him of the discovery, in which Ludwig had himself assisted, and respecting the truth of which he said, his 'master must be quite sure—without doubt.' Mr. Wolley, however, forbore to allow his own or my expectations to be raised too highly, and in spite of his receiving confirmatory evidence on his arrival at Haparanda and on his way up the river, it was not until he had reached Muoniovara, and had satisfied himself by repeated investigation of the whole story, that he trusted himself to write to me positively. His letter, dated 'Muoniovara, 14th September, 1856,' after describing his own doings and those of the friends I had made the preceding year, telling me of the expected scarcity of food, and giving the general results of the nesting season, goes on to say:—

"'I have still to tell you of Ludwig's expedition with Piko Heiki to Sardio, on the Kittila River. It was early in June, and he had to wade over Pallas-tunturi up to his middle in snow. Arrived at Sardio, he found there all at home, deep in dirt and laziness. He soon extracted from them the information that a pair of birds had been about, which they took to be *Turka rastas*; and Ludwig himself had seen such a bird, and this bird's egg was entered in my list. . . . . Ludwig immediately started off into the forest, and sure enough he saw a bird which he thought was *Sidensvans*; but he was not quite sure, for the end of its tail looked white in the sun instead of yellow, as in your picture, but the next day, or in the evening, it was cloudy, and Ludwig saw the yellow; and now he had no longer any doubt. He said he would give all the lads day-money, and they must all search, even if it were for a week, till they found the nest. They sought all that night and the next day till about midday, when a lad called out that he had found the nest; and there it was, with two eggs, about nine feet high on the branch of a spruce. . . . After five days Ludwig snared the old bird—a beautiful cock; and you may fancy with what pleasure I took it in my hand and saw that there were no doubts remaining. Indeed, I had before been pretty confident about it: Ludwig had written that I might be quite satisfied that it was the right bird. Martin Pekka had the picture with him at Sodankyla, and as soon as he came back Ludwig compared the bird with it, and certainty was doubly sure. The other picture went to Gellivara. . . . I do not expect Waxwings in that quarter. You can fancy how eagerly I waited for Ludwig to produce the eggs. With a trembling hand he brought them out: but first the nest, beautifully preserved. It is made principally of black 'tree-hair' (lichen), with dried spruce twigs outside, partially lined with a little sheep's-grass and one or two feathers—a large, deep nest. The

eggs—beautiful! magnificent!!—just the character of the American bird. An indescribable glow of colour about them. Ludwig had made for them such a box, that even if a horse trod upon it it would not break. He tells me he happened to say that they were most like "*Sawirastas*" (common Thrush), and any one wishing to cheat should try that. The report seems to have spread, without the name of its originator being given; for in a week or two after the notorious Sallanhi Johan brought a *Korwa-rastas* (Waxwing), "shot from the nest," with its eggs—the eggs being, as Ludwig at once saw, common Thrush's. The next incident was the arrival of Johan's brother, the still more notorious Niku, but this time with a couple of young birds scarcely able to fly, which he had caught, as he said, out of a brood of five, by Pallas-tunturi. One of these Ludwig has stuffed, and a rare little beauty it is; the other was much knocked about, and Ludwig made nothing of it. Then a little girl, just ten

BOHEMIAN WAXWING.

days ago, brought three eggs from the other side of Nälima (about twenty-five miles from here), which she said were taken on a certain day in July, and were "*Kukhaisen.*" They were undoubtedly Waxwing, but are very badly blown by her as they were just hatching. At Midsummer, Sardio Michel brought in a small batch of *Sidensvans*, with the birds (four in number) to each. So now I have a series, though but a very short one, of this *rara avis in terris*—this forerunner of famine, and of infinite value when one thinks of the uncertainty of getting it again. At the same time I should tell you the Sardio lads found a nest which they believe to have been a last year's *Korwa-rastas*. On this river no one has seen the bird of late years, and very few know it at all. One old fellow, Nalio Aaron, says he saw one north of Nälima in 1853, and another in 1854. Martin Pekka showed the picture to many people in the Sodankyla and Kittila districts, but he could not make out that the bird was at all known, and in all his journeys, when he kept a good look-out, he did not see one; so that even this year it seems to have come very sparingly and locally—just in the district north, east, and south of Pallas-tunturi. In 1853 I told you of a boy, Sieppis Johan, who described a nest of birds he had found some years ago, which, from my interpreter's version, I thought might be that of the Waxwing. The boy, on being shown a skin, said he had never before seen the bird.

"'It is a relief to think that I am not bound to go to Russia next spring unless I like it, as I

before felt that I was. I almost think I may leave the unbounded riches of the Nova Zembla coasts and of the north of Siberia—their Steller's Duck, Curlew, Sandpiper, Little Stint, Knot, Sanderling, Grey Plover, Grey Phalarope—to younger adventurers. . . .

"'Almost every day (and it is now the sixth since that of my arrival here) Ludwig has told me the whole story of the *Sidenswans*' nest, and I am never tired of hearing it:—How the season was very backward; how, in their expedition, he and Piko Heiki were getting very much out of spirits at the little success they met with. How he saw this bird in the sunshine. How, when at last the nest was found, he could scarcely believe his eyes; how he went to it again and again, each time convinced when at the spot, but believing it all a dream as soon as he was at a distance. The rising and falling of the crest of the bird, its curious song or voice—all he is eager to tell over and over again; and I have the fullest version, with all the "I said," "he said," "Michel said," "Ole said," &c. These Sardio lads, as you have heard me say formerly, have a good knowledge of the small birds of their neighbourhood, but they are none of them sure whether they have ever seen *Sidenswans* before. As I have also told you, it seemed to be known to a very few woodsmen on that side of the country under the name of "*Korwa-rastas*" or "*Korwa-lintu*" (Ear-bird). It had occasionally attracted their attention as having feathers on its head standing up like Squirrel's ears. It was not till the second year of my stay here that I ascertained this with certainty. The first summer I believed it to be "*Harrhi*," a bird coming in bad seasons, and properly the common Jay; but it seems that this name is also really sometimes given to *Sidenswans*, and therefore, as well as for other reasons, I am inclined to believe that the bird is only here very occasionally.'"

The Waxwing is about eight inches in length, and is of an elegant form and coloration. The plumage is light greyish-brown, shading gradually off into blue-grey on the rump and upper tail-coverts, and the under surface is pale brownish-grey; the head is ornamented with a low crest, which the bird erects or depresses at will, and is of a more reddish coloration than the rest of the back; a broad, black streak passes through the eye and round the back of the head; the quills are blackish, with a white spot on the tips of the primaries, which is yellow on the outer webs; the secondaries dusky grey tipped with white, eight or nine of the innermost having wax-like appendages; primary coverts tipped with white; tail grey, with a broad band of yellow at the tip, before which is a blackish band; the tips of the feathers also with wax-like appendages; throat black, edged with whitish at the base of the lower mandible, and shaded with rufous below; under tail-coverts chestnut. The female is like the male, but has the wax-like appendages to the wing and tail smaller.

THE SIXTH FAMILY OF THE FINCH-LIKE PERCHING BIRDS.—THE HIRUNDINIDÆ. SWALLOWS.

The researches which osteologists have instituted during recent years into the skeletons of birds have resulted, in some instances, in a change of classification, which must seem strange to those who remember the time-honoured arrangements of Cuvier, and it seems at first sight an unacceptable proposition to separate certain groups so far away from one another in the natural systems. Thus it is doing violence to the old classifications to put the Sun-birds in a different order to the Humming-birds, considering the great similarity in their outward form and habits, and the same may be said of the Swallows and the Swifts. Of the grounds of their separation, however, the following explanation by Professor Garrod* is worthy of attentive study:—

"The common Swift and the common Swallow are birds which intimately resemble one another in many respects. The size and general coloration are much the same. In both the beak is very broad and short, the first bone of the pointed wing, which corresponds to the human upper arm bone,† being also particularly short; whilst the bones of the wing which agree with those of the fore-arm—the radius† and the ulna†—are proportionately very long. In both the feet are small, and the power of progression on the ground feeble, each living almost entirely on the wing, making the smaller insects its staple article of food, and each building its nest in walls or eaves of roofs, not in the branches of trees.

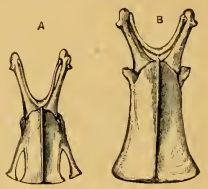
"This collection of external resemblances would generally be accepted as sufficient evidence that the Swallow and the Swift are closely allied birds . . . Further, the fact that the two birds are

* See *Zoologist*, Vol. 35, 1877, pp. 217–220. † See figure of Skeleton of Eagle, Vol. III., p. 241.

described next to one another, or placed side by side in collections, by many of those who are in the habit of employing a systematic method of arranging the different genera, would show that such ornithologists consider the relationship between the Swallow and the Swift to be more intimate than that between either of these birds and the Sparrow, Crow, Starling, Lark, &c. But all these last-named birds are what are known as Passerine; in other words, they possess certain anatomical peculiarities in their organisation, found in them all, and in no other group of birds. If, therefore, the Swift and the Swallow are more nearly related to one another than either is to any other passerine bird, then, as the Swallow is more certainly passerine, the Swift must be so also. But certain naturalists assert that the Swift is not a passerine bird at all, and, if they are correct, it is evident that the Swallow and it cannot have anything to do with one another. Upon this assumption, therefore, the passerine Swallow is much more closely related to the Sparrow, the Crow, and the Lark, than it is to the Swift.

"The question then presents itself—Is it really the case that the importance of the deep-seated anatomical resemblances between the Swallow and the Sparrow, and of the differences between the Swallow and the Swift, is sufficient to justify us, notwithstanding the external similarity between the last-named birds, in believing that the first-mentioned are truly more intimately related the one to the other?

"It may be worth while taking a rapid glance at what some of these important anatomical resemblances and differences happen to be—one of them is the manner in which the feathers are arranged on the skin. Most of us know that, unlike the hair upon a cat or other quadruped, the feathers of a bird are not uniformly distributed over the surface of the body, but grow in linear clusters called *tracts*, with naked intervals, termed *spaces*, between them. This may be readily verified by plucking, say, a Sparrow, and noticing the thick and opaque light-coloured bands formed by the thickening of the skin surrounding the holes, out of which the feathers have been extracted. Between these tracts the skin is seen to be thin and translucent, forming naked spaces through which the colour of the underlying muscles is apparent.



STERNUM OF SWALLOW (A) AND OF SWIFT (B).

"The careful study, some five and forty years ago, by the eminent German ornithologist, C. A. Nitsch, led him to the conclusion, among others, that these feather-tracts are arranged upon a very different plan in the Swallows to what they are in the Swifts, whilst in the Sparrows and their allies they very closely resemble the Swallows. Further, he showed that in this feature the Swifts and the Humming-birds are almost identical. Again, the breast-bone, or sternum, in birds is much expanded to give origin to the powerful muscles of flight. In both the Swallow and the Sparrow, as in passerine birds generally, its usually oblong figure is modified by the presence of two deep notches, one on each side of the keel, in the posterior margin. But in the Swift there are no such notches to be found, the posterior margin being entire, and in other respects it differs from the same bone in the Passeres, whilst in all it resembles the Humming-bird. In the Sparrow and the Swallow, again, as in the great majority of the passerine birds, there is, at the lower end of the trachea, or windpipe, where the bronchi which place it in communication with the lungs arise, an elaborate special mechanism, which is known as the muscular organ of voice or lower larynx, by which they have the power—although they do not at all employ it—of modulating their note, so as to produce a song; this is not found in the Swifts. In man, the greater part of the alimentary canal is composed of a tube of small diameter—the small intestine—which is continued onwards as a more capacious one, the large intestine. These two are not simple continuations one of the other, but the former enters the latter obliquely, the nearer end of the large intestine remaining free as the 'blind gut,' or cæcum. In the Swallow and Sparrow, as in all the Passeres, instead of there being a single cæcum at the place of junction of the two intestines, there are two. These are not found in the Swifts nor in the Humming-birds.

"In the Swallow, the Sparrow, and all their true allies, it is always the case that the tendons which contract up the last joints of the toes, are so arranged that the birds have the power of folding

the toe which corresponds to our great toe (the one directed backwards), without moving any of the others. In the Swift, however, whenever the great toe (the hallux)* is fully flexed, it is impossible that the other toes should remain opened out, because the two muscles, which act on one and the other, are bound together by a tendinous band.

"In the Swallow, the Sparrow, and most singing birds, the number of feathers in the tail is twelve. In the Swifts and Humming-birds the number is always ten—another important difference. In the Swallow also, as in all the passerine birds, there is a slender muscle running through the thin triangular membrane of the wing, between the arm and the fore-arm, which is quite peculiar in the manner of insertion or attachment, no other birds possessing the same arrangement. In the Swift, this muscle terminates in quite a different manner, here again resembling the Humming-birds exactly.

"Taking these several characters into consideration, and realising how little they are susceptible, on account of their deep-seatedness, to the influence of slight external changes in the mode of life of the species, we are inevitably driven to the conclusion that their weight is overwhelmingly greater than that of the superficial similarity, which is so readily brought about by the similarity of the circumstances under which the two species are accustomed to live, and that the resemblances between them are, so far as their constitutions are concerned, dependent only on the fact that they both have —with different pedigrees—arrived at a superficial similarity in contour, because they subsist exclusively on the same food."

The Swallows, then, may be subdivided into two sub-families, called respectively the Rough-winged Swallows and the Smooth-winged Swallows, both of which sub-families are represented in the Old and New Worlds.

THE FIRST SUB-FAMILY OF THE HIRUNDINIDÆ.—THE ROUGH-WINGED SWALLOWS (*Psalidoprocninæ*).

These birds are called "rough"-winged on account of the serrated edge which is found attached to the outer margin of the first primary. So strongly is this indicated that on pressing the thumb along the edges of the feather a distinct feeling of a saw-like sensation is produced. Curiously enough, this feature only obtains in the males, and as far as has been noted at present, is found in two genera, *Psalidoprocne*† in Africa, and *Stelgidopteryx*‡ in the New World. Of the South African Rough-winged Swallow Mr. Layard gives the following brief notice:—"This little Swallow first fell under my notice on the 'Keurboom's River,' Knysna district, where I saw it apparently breeding in holes in the banks, but was unable to investigate its doings more closely. I found it abundantly in the forest, hawking after flies over pools, frequently dipping into the water, and perching on the overhanging boughs in clusters of six or eight, to dry themselves. Their habit of perching is noted by Mr. Cairncross, who writes, 'This bird flies about very much like a bat (this resemblance also occurred to me when I saw it) amongst thick forests, and is generally more visible in rainy, heavy weather; but I have never seen or heard of their breeding here (Swellendam). They remain here after the winter has set in. Sometimes I have seen them roost on trees at the bottom of my garden, where I shot the specimen sent.'"

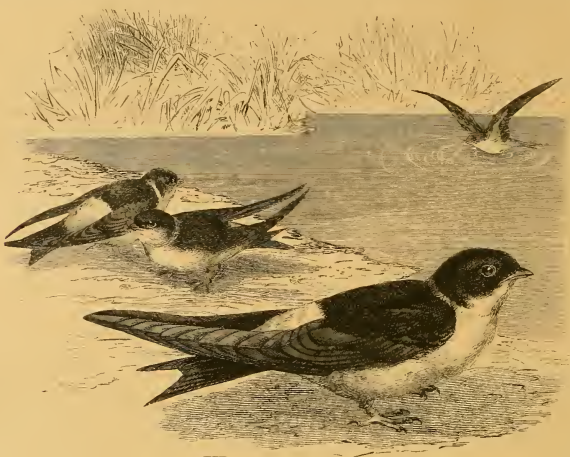
THE SECOND SUB-FAMILY OF THE HIRUNDINIDÆ.—SMOOTH-WINGED SWALLOWS.

To this group of birds belong by far the larger number of the Swallows, including also the Martins and the Sand Martins. It may not be out of place here to note the points by which the three English species of Swallows may be distinguished by an ordinary observer. On the wing, the Swift is very Swallow-like in appearance, but may be told by its large size, extremely rapid flight, long wings, and entirely black plumage. The Sand Martin breeds in holes of banks, and is the smallest of the three English *Hirundines*, being pale brown above and white below. The common Martin builds a mud nest under eaves of houses or barns, like the Swallow, but may easily be told on the wing by a conspicuous white band across the lower back. The forked tail is not perceptible in the Martin when in flight, but is very easily seen in the common Swallow, especially in the male birds, in which the elongated outer tail feathers are very conspicuous at all seasons of the year. When they first arrive,

* See figure of Skeleton of Eagle, Vol. III., p. 241.

† ψαλις, a pair of shears; Πρόκνη, a mythological character. ‡ στελγίς, a scraper; πτερόν, a wing.

also, the males of the common Swallow have a beautiful rufous blush on the under parts, which is very apparent and unmistakable as they turn and twist in the sunlight. In the young birds, in their first autumn plumage, the under parts are whiter and they appear smaller.



MARTIN.

THE COMMON SWALLOW (*Hirundo rustica*).*

Like the Cuckoo, the arrival of the Swallow is anxiously looked for as a sign of approaching summer, arriving as it does in England about the middle of April, by a gradual migration, which appears to pass Spain early in February, Malta early in March, Palestine about the middle of that month, and Italy about the 20th of March; it does not arrive in Scotland before the end of April. The same quarters are occupied year after year probably by the identical birds, if their home of the previous year has been undisturbed. Many experiments have been made with a view to ascertain the truth of the latter assertion, and the following anecdote is mentioned by Buffon† :—

In the year 1779, the winter passed without much snow, and the spring was very fine. The Swallows, however, arrived in Burgundy only by the 9th of April, and on the Lake of Geneva by the 14th. It is said that a shoemaker of Basle, having attached to a Swallow's neck a collar on which he wrote

Hirondelle, qui es si belle
Dis-moi, l'hiver où vas-tu ?

received the following spring by the same courier the answer—

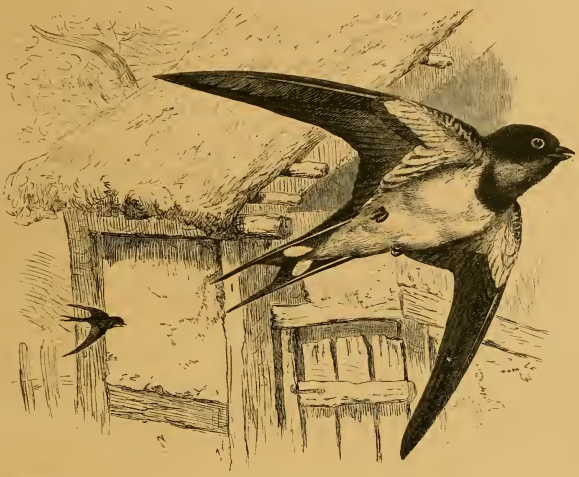
Athènes, chez Antoine,
Pourquoi t'en informes-tu ?

As Buffon himself remarks, the truth of this little anecdote is somewhat dubious; and an English reviewer has also doubted the accuracy of this little story, as well he might, seeing that, as far as we know, the Swallow spends the winter, in which it is absent from Europe, at the Cape of Good Hope, where

* *Hirundo* (Linn.), a proper name; *rustica*, an inhabitant of the country. † "Hist. Nat. Ois." vi., p. 619.

it is a common bird, and where it is probable it rears a second brood of young ones, as Mr. C. J. Andersson says that in "uncivilised parts of Africa these Swallows affix their nests to some projection of a rock or trunk of a tree, or occupy cavities in rocks or banks."

Throughout Europe generally the Swallow is merely a migrant, arriving as one of the first harbingers of summer, and leaving before the cold weather sets in. It is now unnecessary to refute the old fable so current among our forefathers that the Swallows hibernate during the winter season, as it has long been satisfactorily proved that such is not the case; but even in the present century it was found necessary to write long essays to prove that they migrate to more genial climes, instead of passing the winter in a state of torpidity in the mud, or in old caves, or hollow trees. Mr. Benzon, of



COMMON SWALLOW.

Copenhagen, states that in old prescriptions one sometimes finds reference made to *aqua Hirundinum*, a sort of essence of water and Swallows, which in olden times appears to have been considered a sovereign remedy for many of the ills that man is heir to. Being entirely insectivorous, the Swallow is one of the most harmless and useful birds, and in most parts of Europe it is protected by the peasantry, who object to its being molested, and it would be well if this were everywhere the case. Swift on the wing, and extremely agile and graceful, it glides with the greatest ease through the air, the tail being usually carried but little expanded, and only spread out to its full extent when a sudden turn is made, generally to catch a passing insect.

During fine, clear weather, it is usually seen flying at a great altitude; but in damp, dull weather, it skims close to the ground, following every irregularity in it in search of its insect prey. Their great power of flight enables them to persecute and put to flight most of the birds of prey which may happen to intrude on their domain; and on the appearance of any such intruder, they all collect and join in driving him away, in which they generally succeed. For the nest it usually selects some convenient place under the eaves of a roof or on the beam of an outhouse, or in any shed where

ingress and egress are easy; or it will place its nest down the shaft of an old well, on the face of a rock or quarry, or not unfrequently in a chimney, the last-named place being doubtless selected for the sake of warmth.

Not unfrequently, when the Swallow has carefully finished its nest, it is ousted by some stronger bird, who takes possession, and forces the peaceful Swallow to construct a fresh one. Sparrows are often the intruders; but Mr. Benzon gives two instances which have come under his notice, wher the Spotted Flycatcher (*Muscicapa grisola*) has been the aggressor.*

THE SEVENTH FAMILY OF FINCH-LIKE PERCHING BIRDS.

THE TANAGRIDÆ—TANAGERS.

The Tanagers are entirely American, and are described by Dr. Sclater, who has studied the family in detail, as Dentirostral Finches, that is, birds which, having all the essential characters of the Finch, are yet so far modified as regards certain parts of their structure as to fit them for feeding, not on grains and seeds, which are the usual food of the true Finches, but on soft fruits and insects, the habitual food of the true Warblers. The Tanagers are mostly birds of very brilliant plumage, and some of the larger kinds are not unlike the Grosbeaks of the Old World. More than three hundred species are known, the greater part of them being non-tropical, though some few kinds inhabit North America during the summer. Some of the most beautiful of the family are contained in the genus *Calliste*, of which nearly sixty species are known to science, but very little has been recorded of their habits. One of the best known, the Lesser Rufous-headed Tanager (*Calliste cayana*), is said to be very common in British and French Guiana, living in the latter country in open spots and in the vicinity of dwellings, and feeding on bananas and other fruits. It is also said to do much harm in the rice-fields.

Of the Brazilian Turquoise Tanager (*Calliste braziliensis*) the late Prince Maximilian of Neuwied states that he met with numbers in several provinces of Eastern Brazil, but less often in the forests than the more open country, which was varied with wood, and particularly at the edges of the plantations. Here it goes commonly in pairs, perching generally upon the top of shrubs, and feeding on fruits. In the month of November the Prince found a nest of this Tanager placed in a thick bush in a fork formed by the separation of four branches, and built after the fashion of that of the Chaffinch (*Fringilla cœlebs*). It was constructed very neatly of wool, nearly all white, only varied with a few watlets and moss and bark interwoven, and lined within with broad threads of bark. The two eggs which it contained were rather long in shape, marbled with pale reddish-violet upon a white ground, and varied with a few irregular black specks and blotches.† One of the best known of the family is

THE SCARLET TANAGER (*Pyranga rubra*).

An account of the habits of this bird is given in the "History of North American Birds" by Dr. Brewer:—"The Scarlet Tanager is one of the most conspicuous and brilliant of all our summer visitants. Elegant in its attire, retiring and modest in manners, sweet in song, and useful in its destruction of hurtful insects, it well merits a cordial welcome. This Tanager is distributed over a wide extent of territory, from Texas to Maine, and from South Carolina to the northern shores of Lake Huron, in all which localities it breeds. A few are found once in a while as far east as Calais in the spring, and they are rather occasional than common in eastern Massachusetts, but are more plentiful in the western part of the State, becoming quite common about Springfield, arriving May 15th, and remaining about four months, breeding in high open woods and old orchards. In South Carolina it is abundant as a migrant, though a few remain and breed in the higher lands. Mr. Audubon states also that a few breed in the higher portions of Louisiana, and Dr. Heermann found them breeding at El Paso in New Mexico. They are far more abundant, however, in the States of Pennsylvania, New Jersey, Virginia, and throughout the Mississippi valley, arriving early in May and leaving in October. Though occasionally found in the more sparsely settled portions of

* Dresser: "Birds of Europe."

† Sclater: *Mon. Genus Calliste*, pp. 62.

the country, in orchards, and retired gardens, they are, as a rule, inhabitants of the edges of forests.

"Their more common notes are simple and brief, resembling, according to Wilson, the sounds *chip-char*. Mr. Ridgway represents them by *chip-a-ra'-ree*. This song it repeats at brief intervals, and in a pensive tone, and with a singular facility of causing it to seem to come from a greater than the real distance. Besides this it also has a more varied and musical chant, resembling the mellow notes of the Baltimore Oriole. The female also utters similar notes when her nest is approached, and in their mating season, as they move together through the branches, they both utter a low whispering warble in a tone of great sweetness and tenderness. As a whole, this bird may be regarded as a musical performer of very respectable merits.

"The food of this species is chiefly gleaned among the upper branches, and consists of various coleopterous and other insects and their larvæ. Later in the season they consume various kinds of wild berries.

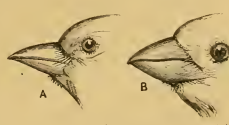
"When their nest is approached, the male bird usually keeps at a cautious distance, as if fearful of being seen, but his much less gaudy mate hovers about the intruder in the greatest distress. Wilson relates quite a touching instance of the devotion of the parent of this species to its young. Having taken a young bird from the nest and carried it to his friend, Mr. Bartram, it was placed in a cage, and suspended near a nest containing young Orioles, in hopes the parents of the latter would feed it, which they did not do. Its cries, however, attracted its own parent, who assiduously attended it, and supplied it with food for several days, became more and more solicitous for its liberation, and constantly uttered cries of entreaty to its offspring to come out of its prison. At last this was more than Mr. Bartram could endure, and he mounted to the cage, took out the prisoner, and restored it to its parent, who accompanied it in its flight to the woods with notes of great exultation.

"Early in August the male begins to moult, and in the course of a few days, dressed in the greenish livery of the female, he is not distinguishable from her or his young family. In this humble garb they leave us, and do not resume their summer plumage until just as they are re-entering our southern borders, where they may be seen in various stages of transformation."

THE EIGHTH FAMILY OF FINCH-LIKE PERCHING-BIRDS.

THE FRINGILLIDÆ—TRUE FINCHES.

The Finches have only nine primary quills, and are divisible into two sections, distinguished by the form of the bill inside. The first section consists of the wide-palate Finches (*Amplipalatales*). In the first section the lower mandible has the cutting edges (*tomium*) of great power, and rising slightly higher on the posterior margin, formed for crushing seeds: the palate is somewhat deeply and broadly arched, with three ridges, rather far apart from one another. The species of this section are mostly characteristic of the Old World, and include among their number all the familiar European Finches and their allies, such as the Bullfinches, Goldfinches, Canaries, Redpolls, Grosbeaks, Chaffinches, and Sparrows. Although a numerous family of birds, the Finches do not offer the great differences in their habits, and a general account of the economy of one of the English species would comprise many of the characteristics of the family generally. It is in the construction of their nests that the Finches greatly differ, this being evidenced by that of the Chaffinch as compared with that of a Bullfinch. The nest of the former is fully described by Macgillivray:—



BILL OF FINCH (A) AND OF BUNTING (B).

"The nest is of moderate size, very neatly constructed, having its exterior composed of moss, lichens, grass, thread, and rags, its interior of wool, feathers, hair, and other suitable materials. Not that all these articles enter into the composition of every nest, for there is great diversity in this respect. When neatly crusted with grey lichens, it is very difficult to distinguish it in the cleft of a

tree, which is the situation usually selected for it; but it is found in a great variety of places, often on tall trees, sometimes in the fork of a shrub, not unfrequently among ivy on a wall, and still more commonly among the twigs of a hawthorn hedge. Gardens, orchards, hedges, groves, copses, and woods are all inhabited by the Chaffinches at this season, but they are very rarely met with in the depth of large woods, especially of those composed of fir. When a person approaches the nest, the birds manifest much anxiety, flying about, or hopping among the twigs, and repeating their

CHAFFINCH.

ordinary tweet in a hurried manner. The female sits very close, and from her colour and that of the nest is seldom perceived, but when aware that she has been discovered, she slips off with alacrity, and joins the male in evincing her anxiety as to the result of the intrusion."

The nesting of the Bullfinch is as follows:—About the beginning of May it begins to construct its nest, which is rather loosely formed of small dry twigs, with a lining of fibrous roots, and is placed in a bush, frequently of hawthorn, or on the horizontal branch of a spruce. The eggs, four in number, are of a rather broad oval form, nine and a half twelfths long, seven and a half twelfths in their greatest diameter, of a bluish or purplish white colour, spotted and streaked with purplish-grey and reddish-brown.

The second section contains the Finches with narrow palates (*Arctipalatales*), which have the finch-like character of the lower mandible less strongly pronounced, the palate being narrower,

SISKIN, BULLFINCH, AND GOLDFINCH.

very little arched, and having two or three keels placed close together. In this section are found the Crossbills and the Buntings, the latter forming a large group of birds which are especially developed in the New World. The palate in most of the last-named birds is remarkable for a long tubercle, which is very plainly seen in an examination of an ordinary Yellow-hammer or common Bunting. The difference in the form of bill between that of a Bunting and true Finch is well represented in Professor Macgillivray's "British Birds." * To the present

WHITE-WINGED CROSSBILL.

section belong the Crossbills, perhaps the most interesting bird of the family as regards its structure. The Crossbills, as a rule, are inhabitants of the northern parts of the Old and New Worlds, though the Himalayas possess one species. The name Crossbill is attached to the bird from the peculiar way in which the mandibles cross each other, giving the bill a very singular appearance. All the species are inhabitants of northern climes, where they frequent conifer forests both in the Old and the New World,† "extracting the seeds of pines and firs from the cones by means of their powerful and curiously-constructed bill, the points of which appear to have received their lateral curvature from the force applied in that direction to separate the scales. The hard, spoon-shaped tongue seems to be the instrument by which the seeds are then taken up. They are gregarious, and wander about in search of their favourite food, appearing at intervals in places not usually frequented by them." With regard to the well-known legend of the Crossbill, the verses of Longfellow on the next page will recur to many readers.

* Plate VIII., Vol. I., Figs. 7, 8.

† Macgillivray: "British Birds," I., p. 414.

THE LEGEND OF THE CROSSBILL.

(From the German of Julius Mosen.)

"On the Cross the dying Saviour
Heavenward lifts His eyelids calm,
Feels, but scarcely feels, a trembling
In His pierced and bleeding palm.

"And by all the world forsaken,
Sees He how with zealous care
At the ruthless nail of iron
A little bird is striving there.

"Stained with blood and never tiring,
With its beak it doth not cease,
From the Cross 'twould free the Saviour,
Its Creator's Son release.

"And the Saviour speaks in mildness:
'Blest be thou of all the good!
Bear, as token of this moment,
Marks of blood and holy rood!'

"And that bird is called the Crossbill;
Covered all with blood so clear,
In the groves of pine it singeth
Songs, like legends, strange to hear."

THE NINTH FAMILY OF FINCH-LIKE PERCHING BIRDS.

THE ICTERIDÆ—HANG-NESTS.

The Hang-nests are a strictly American family, showing affinities to the Starlings and Weaver-birds of the Old World. Many of the species congregate in flocks, and affect the ground like the true Starlings, while their long purse-like nests suggest their affinity with the Weaver-birds. There are three sub-families of the *Icteridæ*, viz., the *Agelæinæ*, or Cow-birds, the *Icterinæ*, or true Hang-nests, and the *Quiscalinæ*, or Grakles. In the first of these sub-families are found the Bobolink (*Dolichonyx oryzivorus*), or Rice-bird, and the Cow-birds; the latter being very interesting on account of their parasitic habits, which resemble those of the common Cuckoo of Europe. Dr. Brewer writes of the common Cow-bird (*Molothrus pecoris*):—"This species is at all times gregarious and polygamous, never mating and never exhibiting any signs of either conjugal or parental affections. Like the Cuckoos of Europe, our Cow Blackbird never constructs a nest of her own, and never hatches out or attempts to rear her own offspring, but imposes her eggs upon other birds; and most of these, either unconscious of the imposition or unable to rid themselves of the alien, sit upon and hatch the stranger, and in so doing virtually destroy their own offspring, for the eggs of the Cow-bird are the first hatched, usually two days before the others. The nursling is much larger in size, filling up a large portion of the nest, and is insatiable in its appetite, always clamouring to be fed, and receiving by far the larger share of the food brought to the nest. Its foster companions, either starved or stifled, soon die, and their dead bodies are removed, it is supposed, by their parents. They are never found near the nest, as they would be if the young Cow Blackbird expelled them as does the Cuckoo; indeed, Mr. Nuttall has seen parent birds removing the dead young to a distance from the nest, and there dropping them."* A very instructive article on the "procreant instincts" of the three species of *Molothrus* found in Buenos Ayres was contributed by that excellent observer, Mr. W. H. Hudson, to the *Proceedings of the Zoological Society* for 1874.

The second sub-family of the *Icteridæ*—viz., the *Icterinæ*—consists principally of the brilliant yellow and black Hang-nests of America, which are popularly called the Orioles of the New World. One of the best known is the Baltimore Oriole (*Icterus baltimora*), a good account of whose habits will be found in the before-mentioned work from the pen of Dr. Brewer. He observes: "The Baltimore Oriole is one of the most common birds nearly throughout New England. Gay and brilliant in plumage, interesting and lively in manners and habits, and a vocalist of rare power, with pathos, beauty, and variety in his notes, this bird has been, and would still be, a great favourite but for his transgressions.

"Among the pea-vines of our gardens he makes his appearance with exemplary punctuality, seeming regardless of the prematureness or tardiness of the season. Rarely does the 10th of May pass without the sound of his welcome notes, and rarely, if ever, does he come sooner. When the male Baltimores first arrive, they come unaccompanied by their mates. At this time their notes are unusually loud, and their voices seem shrill. Their song appears to partake somewhat of the nature of tender

* Baird, Brewer, and Ridgway, "North American Birds," p. 155. This work should be consulted for the history of the true Hang-nests, an interesting account of which is given, but is too long to be reproduced in the present work.

lamentations and complaining. At this period they are very active and restless, moving rapidly through the branches of the trees, just opening into leaf and blossom, searching busily for the insects, which then form their principal food. When, a few days after their arrival, they are joined by the females, the whole character of their song changes, which becomes a lower-toned, richer, and more pleasing refrain. During their love season their resonant and peculiarly mellow whistle resounds in every garden and orchard, along the highways of our villages, and in the parks and public squares of our cities. Nuttall, generally very felicitous in expressing by verbal equivalents the notes of various species of our song birds, describes the notes of its song as running thus: *Tshippe-tschayia-too-too-tshippe—tshippe-too-too*, with several other very similar modifications and variations. But these

COW-BIRD.

characters give a very inadequate idea of their song. It must be heard to be appreciated, and no description can do justice to its beauties. The notes are of an almost endless variety, and each individual has its own special variations. The female, too, has her own peculiar and very pretty notes, which she incessantly warbles as she weaves her curiously elaborate nest. To agriculturists this Oriole renders immense service in the destruction of vast numbers of highly injurious insects; among the most noteworthy of these are the common canker-worm and the tent caterpillars, both great pests to orchards. These benefits far more than compensate for its annoying attacks on the pods of esculent peas, the only sin that can rightfully be brought against it, except, perhaps, the acts of theft committed against other birds, in seizing upon and appropriating to it materials collected by smaller birds for their nests. The Baltimore Orioles are devoted, faithful, and courageous parents, resolutely defending their young when in danger, and exposing themselves fearlessly to danger and to death rather than forsake them. If their young are taken and caged the parents follow them, and, if permitted, will continue to feed them."

In the third family of the Hang-nests are the Boat-tails (*Quiscalus*).

BALTIMORE ORIOLE.

BAYA WEAVER BIRD

CHAPTER VI.

STARLING-LIKE BIRDS AND SONGLESS BIRDS.

THE STURNIFORMES, OR STARLING-LIKE BIRDS—Characters—THE WEAVER BIRDS—Their Extraordinary Nests—Dr. Jerdon's Account of their Habits—Construction of the Nest—Performances of Trained Bayas—THE STARLINGS—Characters—THE COMMON STARLING—Gregarious Habits—THE AFRICAN BEEF-EATER—Their Services to Cattle—THE WOOD SWALLOWS—Mr. Gould's Account of their Habits—THE LARKS—Distinctive Features—Their Habits—Song—THE MESOMYODI, OR SONGLESS BIRDS—Mostly of the New World—THE LYRE BIRDS—THE BUSH WRENS—THE SPINE-TAILS—THE OVEN BIRD—THE AMERICAN ANT-THRUSHES—THE OLD WORLD ANT-THRUSHES—THE TYRANT BIRDS—THE KINGBIRD—Dr. Brewer's Account of its Habits—THE AMERICAN CHATTERERS—THE COCK OF THE ROCK—THE BELL BIRD—THE UMBRELLA BIRD—THE MANAKINS—THE BROADBILLS—THE PLANT-CUTTERS—ORDER OF PIGEONS—Difference between Pigeons and Game-birds—Features—THE DODOS—Now Extinct—History—THE SOLITAIRE—Also Extinct—THE TOOTH-BILLED PIGEON—THE COLUMBIDÆ, OR TRUE PIGEONS—Four Divisions—THE FRUIT PIGEONS—THE TRUE DOVES—THE PASSENGER PIGEON—Its Long-continued Flights—THE BRONZE-WINGS—THE CROWNED PIGEONS.

THE THIRD GROUP OF THE PASSERIFORMES, OR PERCHING-BIRDS.

THE STURNIFORMES, OR STARLING-LIKE BIRDS.

ALL the birds belonging to this series have ten primaries in their wings, the first one being, however, rudimentary, and in some of the Larks so small as to be nearly obsolete, and to require a minute search to discover it at all. Only four families are included in this series, the Weaver Birds, the Wood Swallows, the Starlings, and the Larks. The Weaver Birds and the Larks follow naturally upon the Finches and Buntings, with which birds the previous family of perching birds ended; while the Starlings are not distantly related on the one hand to the American Hang-nests, and on the other hand to the Crows, which they very much resemble in their habit of walking on the ground.

SECTION OF NEST OF WEAVER BIRD.

THE FIRST FAMILY OF THE STARLING-LIKE PERCHING-BIRDS.

THE WEAVER BIRDS (*Ploceidæ*).

As already noticed, the Weavers are not very unlike the Finches. They form rather a numerous family distributed over Africa and India, ranging into the Malayan Peninsula. The nests constructed by these birds—the extraordinary character of which structures has gained them their name of Weaver—are among the most interesting productions of bird architecture, as the specimens in the Natural History Museum at Kensington will show. The following account of the common Weaver Bird of India (*Ploceus baya*) is given by Dr. Jerdon *:—"The common Weaver Bird is found throughout the whole of India, from Cape Comorin and Ceylon to the foot of the Himalayas, and extending into Assam, Burmah, and Malayana. It is most abundant in the well-wooded parts of the country, and in the bare table-land of the Deccan you may travel for days without seeing one. It appears to wander about some localities, for some observers have stated that it is migratory, but it is certainly a permanent resident in most parts of the country; and their roosting places on certain trees are well known. Grain of all kinds, especially rice, and various grass-seeds, form the chief food of the Weaver Bird, and I never observed it feeding on fruit, as Sykes asserts he has known it do on the fig of the banyan tree. Whilst feeding, particularly, as well as at other times, the whole flock keeps up a perpetual chirruping. I have seen it feeding in grain fields in company with flocks of *Emberiza melanocephala;* and Sykes relates that he has seen it associate with the common Sparrow.

"The Baya breeds during the rains, according to the locality, from April to September, but I am

* "Birds of India," Vol. II., p. 244.

not aware if they ever have more than one brood. Its long retort-shaped nest is familiar to all, and it is indeed a marvel of skill, as elegant in its form as substantial in its structure, and weather-proof against the downpour of a Malabar or Burmese monsoon.

"It is very often suspended from the fronds of some lofty palm-tree, either the palmyra, cocoa-nut, or date, but by no means so universally so as Mr. Blyth would imply, for a babool (*Acacia arabica*, or *Vachellia farnesiana*) or other tree will often be selected, in preference to a palm-tree growing close by, as I have seen within a few miles from Calcutta on the banks of the canal. Very often a tree overhanging a river or tank, or even a large well, is chosen, especially, as Tickell says, if it have spreading branches and scanty foliage. In India I have never seen the Baya suspend its nest except on trees, but in some parts of Burmah, and more particularly in Rangoon, the Bayas usually select the thatch of a bungalow to suspend their nests from, regardless of the inhabitants within. In the cantonment of Rangoon very many bungalows may be seen with twenty, thirty, or more of these long nests hanging from the end of the thatched roof, and in one house in which I was an inmate—that of Dr. Pritchard, garrison surgeon there—a small colony commenced their labours towards the end of April, and, in August, when I revisited that station, there were above one hundred nests attached all round the house! In India, in some localities, they appear to evince a partiality to build in the neighbourhood of villages or dwellings; in other places they midificate in most retired spots in the jungle, or in a solitary tree in the midst of some large patch of rice cultivation.

"The nest is frequently made of grass of different kinds plucked when green, sometimes of strips of plantain leaf; and not unfrequently of strips from the leaves of the date palm, or cocoa-nut; and I have observed that nests made of this last material are smaller and less bulky than those made with grass, as if the little architects were quite aware that with such strong fibre less amount of material was necessary. The nest varies much in the length both of the upper part or support, and the lower tube or entrance, and the support is generally solid from the point whence it is hung for two or three inches, but varies much both in length and strength. When the structure has advanced to the spot where the birds have determined the egg compartment to be, a strong transverse loop is formed, not in the exact centre, but a little at one side. If then taken from the tree, and reversed, the nest has the appearance of a basket with its handle, but less so in this than in other species, which have seldom any length of support above. Various authors have described this loop or bar as peculiar to the male-nest or sitting-nest, whereas it exists primarily in all, and is simply the point of separation between the real nest and the tubular entrance, and, being used as a perch both by the old birds and the young (when grown sufficiently), requires to be very strong. Up to this time both sexes have worked together indiscriminately, but when this loop is completed, the female takes up her seat upon it, leaving the cock bird to fetch more fibre and work from the outside of the nest, whilst she works on the inside, drawing in fibres pushed through by the male, re-inserting them in their proper place, and smoothing all carefully. Considerable time is spent in completing this part of the nest, the egg chamber being formed on one side of the loop and the tubular entrance at the other; after which there appears to be an interval of rest. It is at this stage of the work, from the formation of the loop to the time that the egg compartment is ready, that the lumps of clay are stuck on, about which there have been so many conflicting theories. The original notion, derived entirely, I believe, from the natives, was that the clay was used to stick fire-flies on, to light up the apartment at night. Layard suggests that the bird uses it to sharpen his bill on; Burgess that it serves to strengthen the nest. I, of course, quite disbelieve the fire-fly story, and doubt the other two suggestions. From an observation of several nests, the times at which the clay was placed in the nests, and the position occupied, I am inclined to think that it is used to balance the nest correctly, and to prevent its being blown about by the wind. In one nest lately examined there were about three ounces of clay in six different patches. It is generally believed that the unfinished nests are built by the male for his own special behoof, and that the pieces of clay are more commonly found in it than in the complete nest. I did not find this the case at Rangoon, where my opportunities of observing the bird were good, and believe rather that the unfinished nests are either rejected, if built early in the breeding season, or if late, that they are simply the efforts of that constructive faculty which appears, at this season, to have such a powerful effect on this little bird, and which causes some of them to go on building the long tubular entrance long after the hen is seated on her eggs.

"I have generally found that the Baya lays only two eggs, which are long, cylindrical, and pure white, but other observers record a larger number. Sundevall states that he found three in one nest. Layard says from two to four; Burgess six to eight; Tickell six to ten. Blyth thinks that four or five is the most usual number. From many observations, I consider two to be the usual number, but have found three occasionally. In those exceptional instances, where six or more eggs have been found, I imagine they must have been the produce of more than one bird. The Baya is stated not to use the same nest for two years consecutively, and this I can quite understand, without having actually observed it."

The Baya is frequently taken when young, tamed, and taught to pick up rings, or such like articles dropped down a well; or to snatch the ticca-work off the forehead of a person pointed out. It is also taught occasionally to carry a note to a particular place, on a given signal. Mr. Blyth, in an unpublished paper, has the following interesting account of some of this bird's performances:—"The truth is, that the feats performed by trained Bayas are really very wonderful, and must be witnessed to be fully credited. Exhibitors carry them about, we believe, to all parts of the country; and the usual procedure is, when ladies are present, for the bird, on a sign from its master, to take a sweetmeat in its bill, and deposit it between a lady's lips, and repeat this offering to every lady present, the bird following the look and gesture of its master. A miniature cannon is then brought, which the bird loads with coarse grains of powder one by one, or more commonly with small balls of powder made up for the purpose; it next seizes and skilfully uses a small ramrod, and then takes a lighted match from its master, which it applies to the touchhole. All this we have personally witnessed, in common with most persons who have resided in or even visited India; and we have seen the little bird apply the match five or six times successively before the powder ignited, which it finally did with a report loud enough to alarm all the Crows in the neighbourhood, while the little Baya remained perched on the gun, apparently quite elated with its performance." Captain Tytler mentions also "the twirling of a stick with a ball of fire at each end. This the bird turns in several ways round its head, making luminous circlets in imitation of a native practice; the stick being held by the beak in the middle!"

It is further asserted that "in an ordinary cage or aviary they will employ themselves constantly, if allowed the chance, in intertwining thread or fibres with the wires of their prison, merely gratifying the constructive propensity, with apparently no further object, unless, indeed, the sexes are matched, when they breed very readily in captivity, of course provided they are allowed sufficient room, as in a spacious aviary."

THE SECOND FAMILY OF THE STARLING-LIKE PERCHING BIRDS.

THE STARLINGS (*Sturnidæ*).

The Starlings are found only in the Old World, where they form a very large and natural group. They are distinguished by having moderate or long wings, with the first primary always short; the nostrils are oblong, covered with a small soft speculum on the upper edge, more or less feathered, but having a naked edge of rather thicker texture; the forehead is depressed and broad, and there are no rictal bristles. In many species the feathers which cover the nostrils fall off when the bird becomes old; the feet are generally of large size, and robust, and their habits are generally gregarious, most of them frequenting the ground, where they assemble in large flocks. There are two sub-families, the *Sturninæ*, or true Starlings, and the *Buphaginæ*, or Beef-eaters.

THE FIRST SUB-FAMILY OF THE STURNIDÆ.—THE TRUE STARLING (*Sturninæ*).

Of this sub-family there are three divisions, the first containing the Starlings proper, of which the British bird is the type; the second contains the Pastors and Old World Grakles, while in the third division are comprised the Glossy Starlings.

THE COMMON STARLING (*Sturnus vulgaris*).

This is one of the most beautiful of our British birds, and is likewise an inhabitant of the whole of Europe. In Asia Minor and Persia its place is taken by the Purple Starling (*Sturnus purpurascens*), while in Siberia a third species takes its place, which extends to the Himalayas. The habits of the English Starling have been so frequently described that a long account of them is not necessary.

Few people can have visited country districts, or even walked in the parks or open spaces of London itself, without having formed an acquaintance with this familiar bird, who builds his nest with impunity in many of the private houses in the suburbs, or in the public buildings of great cities. In the country they breed in the towers of churches, old buildings, and homesteads, and as soon as the young are reared they frequent the orchards, where they do considerable damage to cherries and other fruits.

COMMON STARLING.

This, however, is amply compensated for by the immense amount of good which the Starling does in destroying the larvæ of noxious insects, and large flocks are seen in the autumn and winter busily engaged in this useful occupation, generally in company with their friends the Rooks. Bishop Stanley furnishes the following interesting evidence respecting the gregarious habits of the present species :—"Not far from the church we have mentioned there is a considerable sheet of water, occupying nearly thirty acres, flanked and feathered on the eastern side by the old beech-wood, already spoken of as the abiding place of the Jackdaws. Its western margin is bounded by an artificial dam, which, as the water is upon a much higher level, commands an extensive view over a flat, rich country, the horizon terminated by the faint outline of the first range of Welsh mountains. This dam, on the finer evenings of November, was once the favourite resort of many persons, who found an additional

attraction in watching the gradual assemblage of Starlings. About an hour before sunset little flocks, by twenties or fifties, kept gradually dropping in, their numbers increasing as daylight waned, till one vast flight was formed, amounting to thousands, and at times, we might almost say, to millions Nothing could be more interesting or beautiful than to witness their graceful evolutions. At first they might be seen advancing high in the air, like a dark cloud, which in an instant, as if by magic, became almost invisible, the whole body, by some mysterious watchword or signal, changing their course, and presenting their wings to view edgeways, instead of exposing, as before, their full expanded spread. Again, in another moment, the cloud might be seen descending in a graceful sweep, so as almost to brush the earth as they glanced along. Then once more they were seen spiring in wide circles on high, till at length, with one simultaneous rush, down they glide with a roaring noise of

AFRICAN BEEF-EATER.

wing till the vast mass buries itself unseen, but not unheard, amidst a bed of reeds projecting from the bank, adjacent to the wood, for no sooner were they perched than every throat seemed to open itself, forming one incessant confusion of tongues."

THE SECOND SUB-FAMILY OF THE STURNIDÆ.—THE BEEF-EATERS.

This sub-family of the Starlings is represented by only two species, both peculiar to Africa. They are very unlike the true Starlings, having a very stout and hard bill, which is straight and swollen just behind the tip; the nostrils are bare; the feet are very short and stout, and are furnished with curved claws, which are extremely sharp.

THE AFRICAN BEEF-EATER (*Buphaga africana*).

Although commonly known as the Beef-eater, it must not be supposed that the birds actually feed on the flesh of the animals whose backs they frequent in order to gain a living. More than one traveller, however, has complained of the wounds caused in the backs of the cattle by these birds in their endeavours to extract the grubs from them. Mr. Andersson gives the following note on the habits

of the South African species :—"The arrival of these birds is announced by a sharp cry; and the next moment they may be seen in a little flock descending fearlessly on and amongst the cattle, which are at first much alarmed, and run about in wild confusion, just as they do when troubled with gadflies; but these apprehensions are soon dispelled, and exchanged for sensations of evident pleasure, as the oxpeckers run over their backs, sides, and bellies, like Woodpeckers upon trees, except when an ox, by an occasional jerk or sudden twist, appears to indicate that the claws of the bird have caused something like pain by touching some spot where the skin of the animal happens to be tender." The same author also alludes to the bird in his "Lake 'Ngami":—"It is also a frequent companion of the Rhinoceros, to which, besides being of service in ridding him of many of the insects that infest his hide, it performs the important part of sentinel. On many occasions has this watchful bird prevented me from getting a shot at that beast. The moment it suspects danger it flies almost perpendicularly up into the air, uttering sharp shrill notes that never fail to attract the attention of the Rhinoceros, who, without waiting to ascertain the cause, almost instantly seeks safety in a precipitate flight."

THE THIRD FAMILY OF THE STARLING-LIKE PERCHING BIRDS.

THE WOOD SWALLOWS (*Artamidæ*).

The exact relations of the present family have been very variously determined by naturalists, some of whom have placed them near the Shrikes. In the wild state they resemble Swallows in their actions and general mode of life, while in the shape of their bills they exhibit great affinities to some of the Shrikes and Crow-shrikes. The food consists of insects, and the habitat of the Wood Swallows is the Australian region, where they are distributed not only over Australia itself, but all over the Moluccas, and one species is found in the Indian Peninsula and the Burmese countries. Mr. Gould writes of the common Wood Swallow (*Artamus sordidus*):—"The Wood Swallow must, I think, ever be a general favourite with the Australians, not only from its singular and pleasing actions, but from its often taking up its abode and incubating near the houses, particularly such as are surrounded by paddocks and open pasture-lands skirted by large trees. It was in such situations in Tasmania that, at the commencement of spring, I first had an opportunity of observing this species. It was then very numerous on all the cleared estates on the north side of the Derwent, about eight or ten being seen on a single tree, and half as many crowding one against another on the same dead branch, but never in such numbers as to deserve the appellation of flocks. Each bird appeared to act independently of the other; each, as the desire for food prompted it, sallying forth from the branch to capture a passing insect or to soar round the tree and return again to the same spot. On alighting it repeatedly throws up one of its wings, and obliquely spreads its tail. At other times a few were seen perched on the fence surrounding the paddocks, on which they frequently descended, like Starlings, in search of coleoptera and other insects. The form of the wing of the *Artamus sordidus* at once indicates that the air is its peculiar province; hence it is, that when engaged in pursuit of the insects which the serenity and warmth of the weather have enticed from their lurking-places among the foliage to sport in higher regions, this species displays itself to the greatest advantage. But the greatest peculiarity in the habits of this bird is its manner of hanging together in clusters from the branch of a tree like a swarm of bees. The season of incubation is from September to December. The situation of the nest is much varied. I have seen one placed in a thickly-foliaged bough near the ground, while others were in a naked fork, on the side of the bole of a tree, in a niche formed by a portion of the bark having been separated from the trunk, &c. The nest is rather shallow, of a rounded form, about five inches in diameter, and composed of fine twigs neatly lined with fibrous roots. I observed that the nests found in Tasmania were much larger, more compact, and more neatly formed than those on the continent of Australia. The eggs are generally four in number; they differ much in the disposition of their markings; their ground-colour is dull white, spotted and dashed with dark umber brown; in some a second series of greyish spots appear as if beneath the surface of the shell. Their medium length is eleven lines, and breadth eight lines."

THE FOURTH FAMILY OF THE STARLING-LIKE PERCHING BIRDS.

THE LARKS (*Alaudidæ*).

In the formation of the scales of the tarsus the Larks very much resemble some of the songless perching birds which will be presently described, but it need scarcely be said that this external

resemblance is entirely counterbalanced by the possession of a musical apparatus, for the ownership of which, as every one knows, the Larks are so famous. They form, however, a natural conclusion to the section of singing Passeres, leading on to the Ant-Thrushes, and the ground-loving, songless birds of the New World. In the formation of the wing the Larks show certain affinities to the Wagtails and Pipits—that is to say, they have the inner secondaries elongated, so as to be about equal to the primaries in length—and they greatly resemble the latter birds in their habits. About one hundred species of Larks are known, and with the exception of the Horned Larks, which are found in America, the vast bulk of the species are inhabitants of the Old World, a great number of them being found in Africa. The hind claw in the Larks, as was also the case in the Pipits, is of varied form, being generally long and straight, as in the case of the Skylarks, but in some of them it is short and rounded.

The common Skylark (*Alauda arvensis*) is an inhabitant of Europe, extending far eastward to the Himalayas, and even to China, but as the bird proceeds to the eastward, certain modifications in the colour of its plumage are noticed, which are considered sufficient by many naturalists to warrant a belief in several species of Skylark.

"There is perhaps none of our native birds," says Macgillivray, "that has attracted so much attention as the Skylark, nor any that has been so much celebrated by poets and sentimental writers. It might be a pleasant task to cull from our choicest authors the flowers of poesy which derive their beauty from the gentle influence of this sweet songster of the fields; but I must leave it for those who love to study Nature from books, as I find it more profitable to listen to the cheering notes of the Lark herself, to gaze upon her as she floats flutteringly high up in the blue sky, to watch her descent, and run up to inspect her nest among the green grass, while her beloved young ones are rejoicing at her arrival. Towards the end of autumn the Skylarks congregate in large straggling flocks, generally keeping by themselves, although occasionally mingling with small birds of the Passerine and Bunting families. In open weather they frequent the stubble and ploughed fields, where they pick up the seeds of oats, wheat, barley, polygonum, and other plants. Like the *Deglubitores*, and many of the *Cantatores*, they use a large quantity of sand and gravel, consisting chiefly of grains of quartz, to aid the process of digestion. I believe their food during the winter consists almost entirely of seeds, although remains of insects may now and then be found in their gizzards. At this season they employ only their ordinary flight, which bears some resemblance to that of the Fieldfare, being performed by slight undulations, and several consecutive flaps of the wings, with short alternate cessations. They generally hover over a field, or fly about in curves, before they alight, which they do in rather an abrupt manner, but not so rapidly as the Corn and Yellow Buntings. On alighting they disperse, and move about, not by leaps, like most small birds, but by an alternate action of the feet, in a half-gliding, half-startful manner, keeping their legs bent and their breasts consequently close to the ground. When in any degree alarmed, they crouch, draw in their neck, and remain motionless until the object of their apprehension has disappeared. Should a person walk up to a flock, he may get quite close to it before the birds think it necessary to rise; and on such occasions they do not all take flight at once, a few here and there rising in succession. Indeed, unless the ground be all gone over, many will remain and allow their companions to fly off. Their movements while rising are rapid and wavering, so that until they are at some distance it is difficult to shoot them. Owing to their habit of crouching, it is by no means easy to perceive them while on the ground, especially if they are among stubble; and as their motions are quick, they traverse a considerable distance in a short time. When there is snow on the ground, they betake themselves to corn-yards, and search the tops of the stacks for seeds; but in frosty weather, when the ground is clear, they prefer settling on the spaces between or around the stacks. If disturbed and forced to fly off, they do not, like the Buntings, Chaffinches, and Sparrows, with which they then associate, perch on the neighbouring trees or walls, but remove to a distance. During this season, they merely utter a short chirping note as they fly, although occasionally a bright day, even so early as January, will elicit their song.

"In the beginning of March, or earlier if the weather is fine, they separate and pair. At this period the males often fight, chiefly in the air; and now their song commences, to be continued until the middle of the autumn. I have heard Larks in full song on the 13th of February in Fifeshire.

This species is perhaps that which, excepting the Whitethroat and the Blackbird, begins to sing earliest in the morning. On the 12th of March, 1835, while on an excursion along the coast, I was greeted at half-past five, between Portobello and Musselburgh, with the full song of the Lark, followed shortly after by those of the Robin and Blackbird, and the harsh cry of the Partridge. In the island of Harris, about the middle of June, in 1820, when on my way to the summit of a hill to see the sun rise, I heard the Lark at half-past one, and soon after the Snipe and Corn Crake. It ceases, however,

SKYLARK.

in the evening much earlier than several of our songsters, especially the Blackbird, Thrush, and Robin. The song of the Skylark is familiar to most persons, even those who in cities have exchanged the love of nature inherent in humanity for the love of gain, fashion, and vicious excitement ; but were it not, it would be as difficult for me to describe it as it would be for a musician to imitate it. Sometimes the Lark sings on the ground, perched on a clod, or even crouched among the grass, but generally in commencing its song it starts off, rises perpendicularly or obliquely in the air, with a fluttering motion, and continues it until it has attained its highest elevation, which not unfrequently is such as to render the bird scarcely perceptible. Even then, if the weather be calm, you hear its warble coming faintly on the ear at intervals. It has been alleged that the Lark ascends in a spiral manner, but my observation does not corroborate the statement. In rising, it often passes directly upward, but with the body always horizontal, or nearly so, then moves in a curve, and continues thus

alternately, but without a continued spiral motion. At first the motion of the wings is uniformly fluttering, but afterwards it shoots them out two or three times successively at intervals, and when at its greatest height exhibits this action more remarkably. When it descends, the song is not intermitted, but is continued until it approaches the ground, when it usually darts down headlong, and alights abruptly. Frequently it resumes its song after alighting, and continues it for a short time, but more commonly it stops when it has reached the ground. Often the Lark may be seen hovering over a field, in full song, for a considerable time at a small height. On the 4th of May, 1837, I observed a Lark perched on a half-twist whin branch, where it remained singing a long time. I have often seen it perch on a wall, and several times on a hawthorn bush in a hedge, but it never, I believe, alights on tall trees.

"The song of the Lark is certainly not musical, for its notes are not finely modulated, nor its tones mellow, but it is cheerful and cheering in the highest degree, and protracted beyond all comparison. In a sunny day in April or May, when the grass-fields have begun to resume their verdure, it is pleasant to listen to the merry songster that makes the welkin ring with its sprightly notes; in the sultry month of July still more pleasant is it to hear its matin hymn while the dew is yet on the corn; and in winter, should you chance to hear the well-known voice on high, it reminds you of the bright days that have gone, and fills you with anticipation of those that are to come. No doubt much of the pleasure derived from the Lark's song depends upon association, and to him who finds delight in wandering over the green fields, along the daisied margin of the clear stream that winds in the bottom of the pastoral glen, or upon the ferny brae, where the 'long, yellow broom' and 'blossomed furze unprofitably gay' shoot up amidst the wild thyme, yarrow, and blue-bell, it is pleasant to listen even to the 'skirl' of the Corn Bunting, the see-saw song of the Tit, the creaking cry of the Partridge, or the singular crake of the Land Rail; but independently of circumstances and associations, the song of the Lark imparts an elasticity to the mind, elevates the spirits, and suspends for a time the gnawing of corroding care. The mellow song of the Merle or Mavis is apt to inspire melancholy, especially if heard in a sequestered valley towards the close of the day, and the feelings which it excites have perhaps as much of a depressing as of a soothing tendency; but the carol of the Lark, like the lively fife, excites pure cheerfulness, and might with propriety be prescribed as an antidote for dulness. It is not merely music that we look for in the songs of birds, but variety, and the expression of passions, feelings and wants. Were all our warblers to tune their throats according to rule we should become sickly and sentimental, and fill the valleys with sighs and groans from the mountain tops; but the loud war-whoop of the Eagle, the harsh scream of the Heron, and the croak of the Raven, are antidotes to the bewitching melody of the Blackcap and Nightingale. I have endeavoured to trace a repetition at regular intervals in the strains of the Lark; but its modulations seem to have no rule. In confinement this bird sings every whit as well as when at large; and when rapidly perambulating the square bit of faded turf in its cage, it enacts its part with apparently as much delight as when mounting towards 'heaven's gate.'"* These last words of Macgillivray's will remind every reader that the Lark has always been one of the chiefest favourites among poets. The Ettrick Shepherd's fine sympathetic lines and Shelley's noble ode, Wordsworth's address and Southey's sonnet, are only a few witnesses to the fact.

The male Skylark is rather larger than the female, and this difference is apparent in winter, when the flocks are mixed together in the fields, the cock bird being conspicuous to a practised observer by his greater bulk when on the wing.

THE SECOND SECTION OF THE PASSERIFORMES, OR PERCHING BIRDS.

THE MESOMYODI, OR SONGLESS BIRDS.

The birds which compose the Mesomyodian section of the Perching Birds belong almost entirely to the New World, with the exception of the *Pittidæ*, or Old World Ant-Thrushes. They are separated from the Acromyodian Perching Birds on account of modifications, which take place in the *syrinx*, "an acromyodian bird being one in which the muscles of the syrinx are attached to the extremities of the bronchial semi-rings, a mesomyodian bird being one in which the muscles of the syrinx join the semi-rings in their middles."†

* Macgillivray: "British Birds." Vol. II., p. 105. † Garrod: *Proceedings of the Zoological Society*, 1876, p. 507.

LYRE BIRD.

THE FIRST FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE LYRE BIRDS (*Menuridæ*).

These curious and interesting birds are found only in Australia, of which they are one of the most characteristic birds. Of the habits of the Prince Albert's Lyre-bird (*Menura alberti*) an excellent account is given in Mr. Gould's "Handbook to the Birds of Australia," from the pen of Mr. A. A. Leycester, portions of which are here transcribed:—"The habits of *Menura alberti* are very similar to *M. superba*. Having seen and watched both on their play-grounds, I find the *M. alberti* is far superior in its powers of mocking and imitating the cries and songs of others of the feathered race to the *M. superba*: its own peculiar song or cry is also different, being of a much louder and fuller tone. I once listened to one of these birds that had taken up its quarters within two hundred yards of a sawyer's hut, and he had made himself perfect in all the noises of the sawyer's homestead, the crowing of the cocks, the cackling of the hens, and the barking and the howling of the dogs, and even the painful screeching or the sharpening and filing of the saws. I have never seen more than a pair together. Each bird appears to have its own walk or boundary, and never to infringe on the others' grounds; for I have heard them day after day in the same place, and seldom nearer than a quarter of a mile to each other. Whilst singing, they spread their tails over their heads like a Peacock, and droop their wings to the ground, and at the same time scratch and peck up the earth. They sing mornings and evenings, and more so in winter than at any other time. The young cocks do not sing until they get their full tails, which I fancy is not until the fourth year, having shot them in four different stages; the two centre curved feathers are the last to make their appearance. They live entirely upon small insects, principally beetles. Their flesh is not eatable, being dark, dry, and tough, and quite unlike that of other birds. They commence building their nests in May, lay in June, and have young in July. They generally place their nests on the side of some steep rock, where there is sufficient room to form a lodgment, so that no animals or vermin can approach. The nest is constructed of small sticks, interwoven with moss and fibres of roots, the inside being lined with the skeleton leaf of the parasitical tree fern, resembling horsehair, and covered in, with the entrance on the side. The single egg laid is of a very dark colour, appearing as if it had been blotched over with ink. The young bird for the first month is covered with down, and remains in the nest about six weeks before it takes its departure."

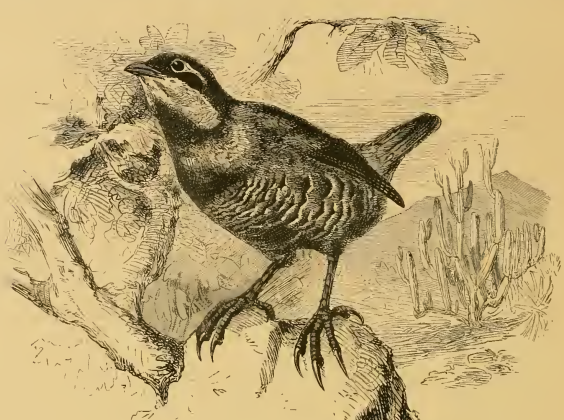
THE SECOND FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE BUSH-WRENS (*Pteroptochidæ*).

This is a small family of birds belonging to South America, and numbering about eight genera and about seventeen species. They are remarkable for their enormous feet, with very distinctly scaled tarsi. Mr. Darwin writes of *Pteroptochus rubecula* in the "Voyage of the *Beagle*":—"In Chiloe, where it is common, it is called by the Indian inhabitants the 'Cheucau.' It frequents the most gloomy and retired spots within the damp forests. Sometimes, although the cry of the Cheucau is heard close by, a person may watch attentively and yet in vain; at other times, if he stands motionless, the red-breasted little bird will approach within a few feet in the most familiar manner. It then busily hops about the entangled mass of rotting canes and branches, with its little tail cocked upwards. I opened the gizzard of several specimens; it was very muscular, and contained hard seeds, buds of plants, occasionally some insects and vegetable fibres mixed with small stones. The Cheucau is held in superstitious fear by the Chilotans, on account of its strange and varied cries. There are three very distinct kinds—one is called 'chiduco,' and is an omen of good; another 'huitrew,' which is extremely unfavourable; and a third which I have forgotten. These words are given in imitation of its cries, and the natives are in some things absolutely governed by them. I was informed by the inhabitants that the Cheucau builds its nests amongst sticks close to the ground."

THE THIRD FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE SPINE-TAILS (*Dendrocolaptidæ*).

These birds resemble very much in appearance the Old World Tree Creepers, the majority of them having, as their name implies, spiny tails like the birds alluded to. They also climb trees after the manner of Creepers. The family is entirely Neotropical, and contains some two hundred and

twenty species comprised in about forty genera. Considerable variation exists in the form of these birds, some of which, as in the genus *Xiphocolaptes*, attain the dimensions of a good-sized Woodpecker, while some are very minute. The family is divided by Messrs. Sclater and Salvin into four sub-families, viz., the *Furnariinæ*, or Oven Birds, the *Sclerurinæ*, containing but one genus, *Sclerurus*, the *Synallaxinæ*, or Spine-tails, and the *Dendrocolaptinæ*, or Woodhewers. Mr. Edward Bartlett, who travelled for some time in the upper districts of the Amazon river, met with two species of *Furnarius*, or Oven Bird. Of the *Furnarius torridus*, he says:—"This bird builds its nest in the banks near the water, like the Swallow or Kingfisher; it is composed of fine sticks and bents very loosely put together. The eggs are four in number and of a creamy white colour, oblong in shape." Of the smaller Oven Bird, the same author relates:—"This interesting little fellow, very different in habits from the preceding species, builds its nest of mud on the bough of a tree. The nest is round,



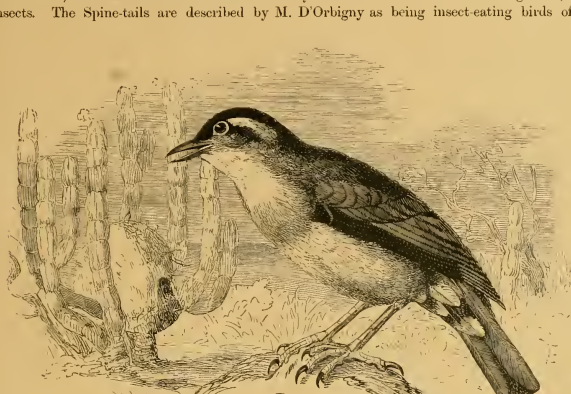
BUSH-WREN.

and consists of an inner chamber, the entrance to which is by a passage formed on one side. The chamber is lined with fine long grass fibres, hairs, &c. The eggs are white, and four in number." Writing of the Rufous Oven Bird, Mr. Darwin observes:—"This bird is common in Banda Oriental, on the banks of the Plata; but I did not see it farther southward. It is called by the Spaniards Casaro, or House-builder, from the very singular nest which it constructs. The most exposed situation, as on the top of a post, the stem of an opuntia, or bare rock, is chosen. The nest consists of mud and bits of straw; it is very strong, and the sides are thick. In shape it resembles a depressed beehive or oven, and hence the name of the genus. Directly in front of the mouth of the nest, which is large and arched, there is a partition, which reaches nearly to the roof, thus forming a passage or ante-chamber to the true nest. At Maldonado, in the end of May, the bird was busy in building. The *Furnarius* is very common in Banda Oriental; it often haunts the bushes in the neighbourhood of houses. It is an active bird, and both walks and runs quickly, and generally by starts. It feeds chiefly on coleoptera. It often utters a peculiar, loud, shrill, and quickly reiterated cry." *

Mr. Darwin, in the same work, also describes the habits of another species, *Furnarius cunicu-*

* Darwin: "Voyage of the *Beagle*" (Birds).

larius, whose habits of nesting, however, are very different. He says:—"It builds its nest at the bottom of a narrow cylindrical hole, which is said to extend horizontally to nearly six feet under ground. Several of the country people told me that when boys, they had attempted to dig out the nest, but had scarcely ever succeeded in getting to the end. The bird chooses any low bank of firm sandy soil by the side of a road or stream. At the settlement of Bahia Blanca the walls are built of hardened mud; and I noticed one, enclosing a court-yard where I lodged, which was penetrated by round holes in a score of places. On asking the owner the cause of this, he bitterly complained of the little *Casarita*, several of which I afterwards observed at work." Mr. Bartlett found two species of *Sclerurus* in the Upper Amazon, and states that these birds are always found in dense forests on the ground, hunting for insects. The Spine-tails are described by M. D'Orbigny as being insect-eating birds of lively



OVEN BIRD.

habits, many of them being very tame, and he mentions how one species, the *Synallaxis troglodytoides* (the Wren-like Spine-tail), visited maritime plants when he was in the neighbourhood of Bahia de San Blas, in Patagonia. Each individual rested hardly two minutes in the same place, being always in motion, running over each branch in turn, ascending and descending incessantly, showing no fear. The whole troop flew off at once and settled again at a little distance off, but on a shot being fired, they all disappeared. The same writer also states that some of the Spine-tails live more in the thickets, and frequent the bushes and big plants, sometimes rather near the water, at others in more arid localities. Many of them are found in the cold regions, as well as the temperate and hot portions of the American continent. Of the Woodhewers, which are larger birds, but little has been recorded as regards their habits. Mr. Salvin states that the Northern Woodhewer (*Xiphocolaptes emigrans*) was seen by him in Guatemala. On each occasion the bird was observed on the trunks of the larger trees, to which it clings just like a Woodpecker, and ascends rapidly to the summit. When pursued, it takes short flights, of about one hundred yards or so to another tree, alighting on it near its base, and again ascending to the top of its stem, whence another flight is taken.

THE FOURTH FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE AMERICAN ANT-THRUSHES (*Formicariidæ*).

As in the case of so many other Mesomyodian birds, the *Formicariidæ* are entirely inhabitants of the New World. About two hundred and twenty species are known to science, and these are arranged in two sub-families, the first of which, the *Thamnophilinæ*, contains the birds which are popularly known as American Bush Shrikes. These have an aspect very similar to the Bush-Shrikes (*Dryoscopus*) of Africa, while in their habits they also resemble the Butcher-birds of the Old World. M. D'Orbigny writes:—"They are, in America, the representatives of our Shrikes, with this important difference in their habits, that instead of invariably perching on bushes, they are found always in the interior, and rarely appear outside. They are bush-birds *par excellence*, all living to the east of the Andes; at least we do not know of any which has been brought from the west of that great chain. They live in all the localities where dense thickets are to be found, either in the hedges near houses or in the deserted clearings in the heart of the forest, or else in the stunted thickets, bristling with thorns, which are called chaparrales by the Spaniards, and which are characteristic of certain parts of Central South America. They go as a rule either alone or in couples, and the most familiar of them approach inhabited places, springing from branch to branch at the bottom of the bushes, which they scour in search of insects and their larvæ, and ants. They very rarely descend to the earth, and then only for the purpose of seizing their prey, which they afterwards proceed to devour on the lowest branches of the thicket. They appeared to us resident in the countries of which they were natives, but always going from one place to another. What traveller in the heart of these wild situations so common in America has not been struck, especially in spring-time, by the vociferous songs of the Bush Shrikes, and with the noisy gamut that the males give out, especially at the season of love? Their whole frame trembles with happiness; their crest raises itself; they open their wings, and show every sign of pleasure, whilst the female hastens to reply to their transports, but in accents less pronounced. These conversations often strike the ear, but one may search in vain for the performer, the birds being almost always hidden in thickets so dense that the rays of the sun scarcely penetrate them. It is in such places as these that they even deposit their nest at some feet above the ground. It is made of twigs outside, and sometimes lined with hair inside. Their eggs very much resemble those of our Shrikes, in that they are often whitish, spotted with reddish-violet."

THE FIFTH FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE OLD WORLD ANT-THRUSHES (*Pittidæ*).

The members of this family, which represent in the Old World the Ant-Thrushes mentioned in the preceding family, are, unlike the latter, birds of very striking and brilliant plumage. From Australia, throughout the Molucca Islands, they range through the Malayan Peninsula and Burmese countries into China, several species inhabiting the Himalayan Mountains, while one is common to the Indian peninsula and in Ceylon. The genus then disappears from the intervening countries, but is once more represented by the Angola Pitta (*Pitta angolensis*) in West Africa; this species, however, appears merely to inhabit the coast line. Most of the Pittas appear to be migratory. They nest on the ground, or on low branches close to the ground. Of the habits of the Blue-winged Pitta an excellent account has appeared from the pen of Mr. W. Davidson:*—"For many months after my arrival in Burmah I did not meet with this species; but while at Tavoy, towards the latter end of April, after a few good showers of rain, they suddenly appeared in great numbers in the gardens and plantations in and about Tavoy. Before the rain, I can safely affirm that there were none about the place, for day after day for the greater part of the month had I been working the country in which they subsequently became so numerous. From this time till I left Burmah, in July, they were numerous everywhere. Subsequently I have, year by year, noticed the annual emigration throughout the southern and central portions of the province. Very likely they extend to the north, but I have never been there at the right season. I suspect, however, that they are rather a coast-loving species. Although the great mass of the birds come as described, a few, I think, remain all the year round in the mangrove swamps of the southern extremity of the province; at any rate, I have found them there from January to July. This species is very fond of perching

* "Stray Feathers," 1878.

on trees; you may continually see them high up upon trees calling vociferously. They are not at all wild or shy birds; they feed freely on ants and their larvæ, all insects, grubs, and land shells. I never noticed this or any of its congeners coming to the water to drink. This, and the closely-allied *P. megarhyncha*, seem to frequent most commonly their tree jungle, where there is not much underwood, and the mangrove swamps, but they also occur abundantly in gardens and plantations. They both have a fine clear double note, which may constantly be heard in the morning and evening wherever they occur. They are decidedly noisy, and often call all day, and, on moonlight nights, a great part of the night also."

THE SIXTH FAMILY OF THE MESOMYODI, OR SONGLESS PERCHING-BIRDS.

THE TYRANT BIRDS (*Tyrannidæ*).

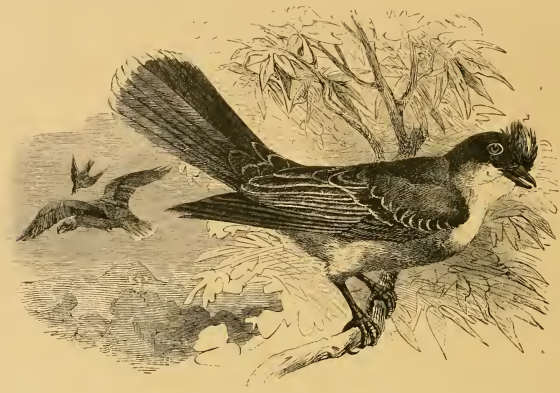
This family is one of the most characteristic of the many which are peculiar to the New World. In the flattened bill, and the great development of the rictal bristles, they bear great resemblance to the Flycatchers of the Old World, but the structural peculiarities of their tarsus, which has the scales arranged in a different manner, in addition to the different formation of the voice-organ, sufficiently serves for the separation of the families *Tyrannidæ* and *Muscicapidæ*. More than three hundred species are now known to science, not thirty of which are found within the limits of the United States, so that the vast bulk of the Tyrant birds are peculiar to Southern and Central America.

THE KINGBIRD (*Tyrannus carolinensis*).

This is one of the North American species of Tyrants ranging over a wide expanse of country, and visiting Central America in winter. The following account of the species is given in the "History of North American Birds," by Dr. Brewer:—"No one of our common birds possesses more strongly-marked characteristics of manners and habits than this species. Its pugnacious disposition during the breeding season, the audacious boldness with which it will attack any birds larger than itself, the persistent tenacity with which it will continue these attacks, and the reckless courage with which it will maintain its unequal warfare, are well-known peculiarities of this interesting and familiar species. Its name, Kingbird, is given it on the supposition that it is superior to all other birds in these contests. My own observations lead me to the conclusion that writers have somewhat exaggerated the quarrelsome disposition of this bird. I have never, or very rarely, known it to molest or attack any other birds than those which its own instinct prompts it to drive away in self-defence, such as Hawks, Owls, Eagles, Crows, Jays, Cuckoos, and Grakles. These it will always attack and drive off quite a distance from their nests. Nothing can be more striking than the intrepidity with which one of these birds will pounce upon and harass birds vastly larger and more powerful than itself. The Kingbird is always prompt to perceive the approach of one of these enemies, and always rushes out to meet it; mounting in the air high above it, it pounces down upon its back, upon which it will even rest, furiously pecking at the exposed flanks of its victim, and only leaving it to descend again and again with the same unrelenting animosity. In these encounters it always comes off conqueror. Wilson states that his jealous affection for his mate, and for his nest and young, makes him suspicious of every bird that happens to pass near his residence. But this is not the case in all instances. A pair of these birds nested in the summer of 1871, and peacefully reared their young in an apple-tree near my residence, within four feet of the nest of the Baltimore Oriole, and not more than eight or ten feet from the nest of a Robin, all in the same tree. The three pairs were on evident terms of amity and mutual good-will. The male Kingbird kept a sharp look-out for danger from the topmost bough, and seemed to have all under his special guardianship, but showed no disposition to molest or annoy them.

"The Purple Martin is said to be the implacable enemy of the Kingbird, and one of the few birds with which the latter maintains an unequal contest. Its superiority in flight gives the former great advantages, while its equal courage and strength render it more than a match. Audubon relates an instance in which the Kingbird was slain in one of these struggles. Wilson also relates an encounter, of which he was an eye-witness, between one of this species and a Red-headed Woodpecker, in which the latter, while clinging on the rail of a fence, seemed to amuse itself with the violence of the King-

bird, playing bo-peep with it round the rail, while the latter became greatly irritated, and made repeated, but vain attempts, to strike at him. The Kingbird feeds almost exclusively upon winged insects, and consumes a vast number. It is on this account one of our most useful birds, but unfortunately for its popularity it is no respecter of kinds, and destroys large numbers of bees. In districts where hives of honey-bees abound the Kingbird is not in good repute. Wilson suggests that they only destroy the drones, and rarely if ever meddle with the working bees. But this discrimination, if even real, is not appreciated by the raisers of bees, who regard this bird as their enemy. The Kingbirds arrive in Pennsylvania the latter part of April, and in New England early in May, and leave for the south in September. They nest in May, selecting an upper branch, usually of an isolated tree, and often in an exposed situation. Their nests are large, broad, and comparatively shallow, and coarsely, though strongly, made of rude materials, such as



KINGBIRD.

twigs, withered plants, bits of rags, string, &c. These are lined with fine rootlets, horsehair, and fine grasses.

"The Kingbird has no song, but instead utters an incessant monotonous succession of twitterings, which vary in sharpness and loudness with the emotions that prompt them. The flight of the Kingbird, when on the hunt for insects, is very peculiar and characteristic. It flies slowly over the field with rapid vibrations of the wings in the manner of Hawks, and soars or seems to float in the air in the manner of a Swallow. It also exhibits great power and rapidity of flight when rushing forth to encounter a Hawk or an Eagle. As they are known occasionally to plunge into the water, and, emerging thence to resume their seat on a high branch, to dry and dress their plumage, it has been conjectured that they feed on small fish, but this is unsupported by any positive evidence. Though the Kingbird usually builds in trees, it does not always select such situations. In the summer of 1851, passing over a bridge near the village of Aylesford, in Nova Scotia, I observed a Kingbird fly from a nest built on the projecting end of one of the planks of which the bridge was made. So remarkably exposed a position, open to view and on a level with and within a few feet of a highway, must be quite unusual. The eggs of this bird are five, sometimes six, in number, and vary considerably in size. Their ground colour is white with a more or less decided roseate tinge, beautifully spotted with blotches and markings of purple, brown, and red-

brown. In some these are disposed in a confluent crown around the larger end; in others they are irregularly distributed over the entire egg. In length they vary from 1·05 to ·86 of an inch, and in breadth from ·72 to ·70 of an inch."

THE SEVENTH FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE AMERICAN CHATTERERS (*Cotingidæ*).

To this family belong nearly a hundred species of birds, mostly of gay plumage, which are found in the New World. Some of the most interesting are the brilliantly coloured Cotingas, or Chatterers

COCK OF THE ROCK.

of South America, in which the plumage is of a mingled blue and crimson; but there are also in this family equally familiar birds, such as the Cocks of the Rock, the Umbrella birds, and the Bell-birds. The habits of the common Bell-bird are described by Mr. Waterton in his "Wanderings." Speaking of the several Cotingas of the country under notice, he says:—"The fifth species is the celebrated 'Campanero' of the Spaniards, called 'Dara' by the Indians, and 'Bell-bird' by the English. He is about the size of the Jay. His plumage is white as snow. On his forehead rises a spiral tube nearly three inches long. It is jet-black, dotted all over with small white feathers. It has a communication with the palate, and when filled with air it looks like a spire; when empty it becomes pendulous. His note is loud and clear, like the sound of a bell, and may be heard at the distance of three miles. In the midst of these extensive wilds, generally on the dried top of an ancient wood, almost out of your reach, you will see the Campanero. No sound or song from any of the winged inhabitants of the forest, not even the clearly pronounced 'Whip-poor-will' from the Goatsucker, causes such astonishment as the toll of the Campanero. With many of the feathered race he pays the common tribute of a morning and evening song; and even when the meridian sun has shut in silence

the mouths of almost the whole of animated nature, the Campanero still cheers the forest. You may hear his toll and then pause for a minute, then another toll and then a pause again, and then a toll and again a pause; then he is silent for six or eight minutes and then another toll, and so on. Acteon would stop in mid-chase, Maria would defer her evening song, and Orpheus himself would drop his lute to listen to him, so sweet, so novel, and so romantic is the toll of the pretty snow-white Campanero. He is never seen to feed with the other Cotingas, nor is it known in what part of Guiana he makes his nest."

With regard to the spiral tube on the forehead, or caruncle, Mr. Salvin remarks*:—"From dried specimens it is impossible to make any satisfactory dissection of the caruncles, to ascertain whether or not any communication exists through means of which air could be passed so as to inflate them and

UMBRELLA BIRD.

cause them to become rigid. On opening the caruncle of an immature male, I found that fine fibrous tissues adhered to the enclosing skin. This would show that in life the caruncle is not hollow, and that, if the internal structure is cellular and capable of inflation by air, these tissues would prevent the outer skin from swelling and taking a bladder-like form. If inflation actually is produced, as analogy with the Cayenne-bird, as described by Mr. Waterton, would certainly suggest, it still remains to be seen from what source the air pressure is derived. The question, too, arises, Is the inflating apparatus, if I may so call it, the growth of the maturing male, as are the caruncles themselves? My own impression is that no inflation takes place, and that the bird possesses little or no voluntary muscular control over these excrescences, but that contraction or elongation takes place, as in the fleshy protuberance over the bill of the common Turkey. The same appears to be the case with the several members of the genus *Cephalopterus* (Umbrella-birds), one species of which is said to gather its throat-lappet under its throat in a bunch like a rose. A muscular contraction would cause one of these caruncles to become more rigid, as in the familiar case above cited."

* "Ibis," 1865, p. 93.

THE EIGHTH FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE MANAKINS (*Pipridæ*).

The Manakins are closely allied to the Tyrants, and form a small family of American birds, consisting of about sixty species. All the Manakins are of small size, and inhabit the wooded portions of South America, and they are somewhat shy in their habits. Of the latter, however, very little has been recorded.

THE NINTH FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.
THE BROADBILLS (*Eurylæmidæ*).

In appearance the Broadbills most resemble some of the broad-billed Rollers (*Eurystomus*) with which they have been commonly classed by naturalists, but of late years more minute study of

BROADBILL

their anatomy and general structure has resulted in placing them near the Chatterers of America of which they appear to be a representative form in the Far East. The species are only about seven in number, all of them being confined to the Himalayan Mountains, the hills of the Burmese countries, the Malayan peninsula, and the Indo-Malayan islands. Writing of these birds in Tenasserim, Mr. Davidson says:—"The Broadbills, I think, might well be designated a stupid set of birds, but the Lunated Broadbill (*Serilophus lunatus*) is the most stupid of the lot. They usually move about in small parties, and when one meets with a party every bird of which it consists can without difficulty be secured, as the birds take no notice of their companions being shot, and do not appear to be at all alarmed at the report of the gun, seldom moving farther than the next branch, sometimes not moving at all, when the gun is fired. Their note consists of a single chir-r-r-r. They never walk or hop about the branches, though they will fly from branch to branch. They feed chiefly on insects, many of which they seize on the wing." * The same author writes of the Sumatran

* "Stray Feathers," 1878, p. 89.

Broadbill (*Corydon sumatranus*):—"This species is spread throughout Tenasserim, but is nowhere abundant, being found in pairs or small parties, usually in moderately thin forest, but it occurs also in dense forest. During the day it is sluggish, and a party will, like *S. lunatus*, allow themselves to be shot one after the other without any attempt to escape.

"They have an oft-repeated, mellow, rather musical note, quite different from, and not at all of the same class as that of the preceding species, and also a clear whistle, which they utter when flying from tree to tree. It does not ascend the higher hills, nor indeed do any of the preceding species. Not only is their note entirely different, but they are far more sluggish than the rest of the Broadbills, feeding almost exclusively morning and evening, and sitting for hours motionless on a branch, sometimes high up and sometimes low down, in a slouching attitude, with their necks drawn in and their bills pointing upwards. They are not at all shy, and by no means curious about what is passing around them; but one day, when I was waiting by a clear pool, watching for *Alcedo nigricans*, one came and sat on a branch about ten feet distant. He clearly thought me a very strange animal, for though he did not attempt to go away, he kept craning out his neck, and peering down at me in a stupid inquisitive fashion. Thus we remained for about two hours, when a Kingfisher not appearing, I shot my stupid neighbour."

THE TENTH FAMILY OF THE MESOMYODI, OR SONGLESS BIRDS.

THE PLANT-CUTTERS (*Phytotomidæ*).

Only three species of Plant-cutter are known, one inhabiting Chili, a second the Argentine Republic, and a third Bolivia. In appearance they resemble a Finch or Tanager, and have been placed by many authors in the vicinity of the last-named birds. D'Orbigny writes:—"This singular genus, well characterised by the numerous teeth in the cutting edges of the mandibles and of the interior of the upper mandible, has, moreover, like the Tanagers of the genus *Saltator*, a strong tooth near the extremity of the bill; the wings are short; the tail rather long and equal." The same writer thinks that the Plant-cutters should not be moved far from the Tanagers in the natural system, as they resemble the latter birds a good deal in the form of the bill. In habits the Plant-cutters are still more like the latter birds, for they both live in the bushes and on the shrubs, where they feed on fruits, berries, and buds, like the *Saltatores*, and they are constantly found in society with them.

PLANT-CUTTER.

Speaking of the Narrow-billed Plant-cutter (*Phytotoma angustirostris*), the same author observes :—"It was seen in several localities in the Andes of Bolivia, always in the temperate zone, in dry and arid situations on the *coteaux* and the plains, without ever descending into the hot valleys, which are wooded and moist. One might say that the temperature which it prefers is that where wheat can be grown, and it was never observed by us either above or below this limit. It is always met with in the neighbourhood of habitations and cultivation, and is very common ; it is seen throughout the year either singly, in pairs, or in small troops. When mingled with the *Saltatores* it traverses the bushes, the gardens of the towns, devastating the plantations, where it cuts off the buds, and spoiling the fruits, doing this without any danger, as up to the present time the people are content with complaining of this inconvenient parasite without seeking any means to stop its ravages. Its flight is short and low, and never long sustained ; its habits resemble those of the *Saltatores*, but we have nevertheless observed it on the ground. Its cry, which is often repeated, could not be much more disagreeable, as it resembles the noise made by the grating of the teeth of one saw against those of another. At certain seasons the Plant-cutter is very fond of the fruit of a species of *Solanum*, which imparts to the beak a violet colour."

THE FOURTH ORDER OF BIRDS.—THE DOVES (*Columbæ*).

In many respects the order *Columbæ* resembles the Gallinaceous birds, or *Gallinæ ;* but there is a fundamental difference between these two orders in the way in which the young are hatched, the nestlings of the Game-birds being very active and able to shift for themselves on their escape from the egg, while the young of the Pigeons are born naked and helpless. It is probably owing to a certain superficial resemblance in the form of the bill, and possibly to the resemblance between the Crowned Pigeons and some Game-birds, that these two orders have been so generally allied together in modern classifications. In the Pigeons the bill is formed not unlike that of the Plovers, the basal part being bare and covered with a thick soft skin ; the apical part of the bill, however, is horny and hard in texture, convex in shape, and higher than the soft part. The nostrils are placed rather low in the soft part, near the base of the bill, and are longitudinal in shape.

The *Columbæ* may be divided into three families, as detailed below :—

THE FIRST FAMILY OF THE PIGEONS.—THE DODOS (*Dididæ*).

As everybody knows, the curious Pigeon called the Dodo is now extinct. As far as we are aware its range was always very restricted, being confined to the southern portion of the island of Mauritius. In size the Dodo was a little larger than a Turkey, and was incapable of flight, although it is said to have progressed rapidly over the ground. Mr. Strickland * gives the following account :—"In 1644 the Dutch first colonised the island of Mauritius, and it is probable that these gigantic fowls, deprived of flight, slow of foot, and useful for food, were speedily diminished in number, and finally exterminated, by the thoughtless rapacity of the early colonists. Their destruction would be further hastened, or might be mainly caused, by the dogs, cats, and swine which accompany man in his migrations, and are speedily naturalised in the forests. To such animals the eggs and young of the Dodo and other birds would be a dainty treat ; and that this is no mere conjecture is proved by Leguat, who tells us : 'Here (in Mauritius) are hogs of the China kind. . . . . These beasts do a great deal of damage to the inhabitants by devouring all the young animals they can catch.' That the destruction of the Dodos was completed by 1693 may be inferred from the narrative of Leguat, who in that year remained several months in Mauritius, and enumerates its animal productions at some length, but makes no mention whatever of Dodos. He further says : 'L'isle était autrefois toute remplie d'Oyes et de Canards sauvages ; de Poules d'Eau, de Gelinottes, de Tortues de mer et de terre ; *mais tout cela est devenu fort rare !*' This passage proves that even in 1693 civilisation had made great inroads on the fauna of Mauritius.

"In 1712 the Dutch evacuated Mauritius, and the French colonised the island under the new name of Isle de France. This change in the population will account for the absence of any traditionary knowledge of so remarkable a bird among the later inhabitants. All subsequent evidence is equally

* Strickland and Melville : "The Dodo and its Kindred," p. 27.

negative. Baron Grant resided in Mauritius from 1740 to 1760; and his son, who compiled the 'History of Mauritius' from his papers, states that no trace of such a bird was to be found at that time. M. Morel, a French official who resided there previously to 1778, and whose attention seems to have been drawn to the subject by the judicious criticisms of Buffon, tells us that the oldest inhabitants had no recollection of these creatures. The late M. Bory de St. Vincent remained for some time in Mauritius and Bourbon in 1801, and has left an excellent work on the physical features of these islands. He assures us that he made every possible inquiry respecting the Dodo and its allies, without gaining the slightest information from the inhabitants on the subject. At a public dinner at

DODO.

the Mauritius in 1816, several persons from seventy to ninety years of age were present who had no knowledge of such a bird from recollection or tradition. Mr. J. V. Thompson also resided for some years in Mauritius and Madagascar previously to 1816, and he states that no more traces of the existence of the Dodo could then be found than of the truth of the tale of 'Paul and Virginia,' although a very general idea prevailed as to the reality of both. This list of negative witnesses may be closed with the late Mr. Telfair, a very active naturalist, whose researches were equally conclusive as to the non-existence of Dodos in Mauritius in modern times."

Besides the Dodo of Mauritius, which island appears to have contained other extinct wingless birds, there existed in the neighbouring island of Rodriguez another remarkable Pigeon, called the Solitaire (*Pezophaps solitarius*), of which a number of relics were brought to England by the naturalist attached to the Transit of Venus Expedition of 1874, so that nearly perfect skeletons of male and female birds are now to be seen in the Natural History Museum at Kensington.

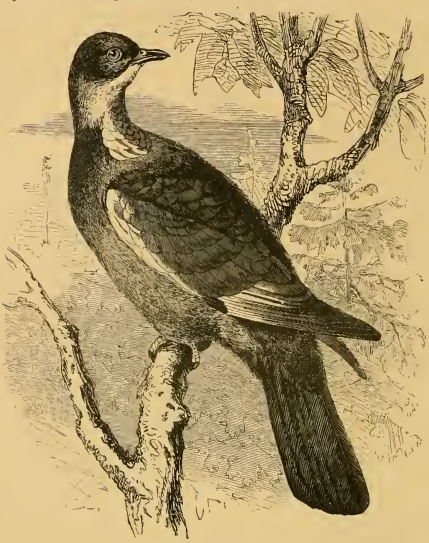
In the Samoan Islands, far from the Mascarene group which contained the flightless pigeons, whose ill developed wings afforded them no protection against the cats and pigs of the colonists, there exists at the present day a bird which is nearly related to the extinct Dodo. This is the Tooth-billed Pigeon (*Didunculus strigirostris*), a species which seemed a few years ago to be decreasing in numbers, owing to its living upon the ground, when the bird became liable to the fatal onslaughts of cats during

SOLITAIRE.

the night, while its eggs ran the risk of destruction by rats. Within the last ten years, however, this pigeon has entirely changed its habits, roosting and breeding on high trees. The Rev. S. J. Whitmee, to whom we are indebted for our knowledge of the habits of this species, attributes to it considerable intelligence. "This intelligence," he writes, "seems to have enabled the bird to change its habits for self-preservation. It has probably been frightened when roosting, or during incubation, by the attacks of cats, and has sought safety in the trees. Learning, from frequent repetition of the fright, that the ground is a dangerous place, it has acquired the habit of building, roosting, and feeding upon the high trees; and this change of habit is now operating for the preservation of this interesting bird, which was a few years ago almost extinct."

THE SECOND FAMILY OF THE PIGEONS.—THE COLUMBIDÆ, OR TRUE PIGEONS.

In this large family the bulk of the Pigeons, some four hundred in number, are located. All of them have the nostrils narrow in shape and situated close to the cutting edge of the mandible, with which they run parallel. On the upper part of the bill there is a convex soft skin, which forms a tubercle. Sundevall divides the true Pigeons into four divisions; in the first are included all the Fruit Pigeons, which are inhabitants of the tropical portion of the Old World, and whose prevailing style of colour is green. They all have the tarsus shorter than the middle toe. There are two subdivisions of the Fruit Pigeons; in the first the bill is stouter than the tarsus, and in this division are found all the Green Fruit Pigeons, of which writes Dr. Jerdon *:—"The Green Pigeons are a well-marked division, all having a marked physiognomy, by which they can be recognised at a glance. They are of tolerably stout and massive form, and of a dull leaf-green colour, more or less varied with ashy and marone above, with yellow on the wings, and with orange or buff beneath. The eyes of most are very beautiful, being blue with a red outer circle. They are more or less gregarious, according to the species. When hunting for fruit they are continually gliding about the branches, like Squirrels; and from their strong feet they can hang over to seize a fruit, and recover their position at once by the strong muscles of their legs. When perfectly quiet they are very difficult to observe, from the similarity of their tints to that of leaves. They nidificate on trees, making a loose nest of twigs, and laying two white eggs. A few are found in Africa and Madagascar, but the majority are denizens of India and Malayana, not extending as far as Australia; but one species at least occurring as high north as Japan, although they appear to be rare in China. They all afford excellent eating, but the skin is very tough and thick, and ought to be removed."



RING DOVE, OR WOOD PIGEON.

In the present section also occur the beautiful *Ptilopi*, which are distributed in great numbers over the islands of the Malay Archipelago, Australia, and Oceania, as well as the large Imperial Pigeons called *Carpophaga*, which have a similar distribution to the *Ptilopi*, with the exception that they extend into the Indian peninsula. "These Pigeons are of very large size, and adorned in many cases with rich and metallic colours, with the lower parts usually pale and glossless. The tarsus is very short and the feet broad, enabling them to grasp the branches well. The forehead is low in its profile, and the feathers advance on the soft portion of the bill. Their gape is wide, and they are enabled to swallow very large fruit; and the feathered portion of the chin advances far towards the

* "Birds of India," Vol. III., p. 445.

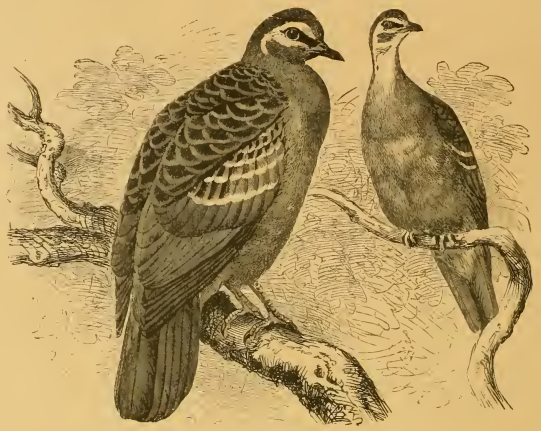
tip of the lower mandible, thus increasing the width of the gape. All those whose nidification is known lay but one egg."*

In the second division of the True Pigeons the tarsus is short, as in the previous division, feathered in front but bare at the sides; the front toes are more slender and rather smooth, the hind toe is broad at the base, and the wing is long. In this division are found the True Doves, to which belong the English Wood Pigeon, Stock Dove, and Rock Dove; the latter being the wild stock from which Domestic Pigeons have been derived. In the third division, wherein the tail is very long, graduated, and pointed, are found the Cuckoo Doves (*Macropygia*) and the Passenger Pigeon of America. This latter extraordinary bird has occasionally been met with in England; it is to be found all over the United States, and Dr. Brewer writes† :—"The Wild Pigeon appears to be almost entirely influenced in its migration by the abundance of its food, excepting in those parts of the country in which it has not been known to remain during winter. Even in these movements it is largely influenced by instinctive considerations of food. Evidently the temperature has but little to do with their migrations, as they not unfrequently move northward in large columns as early as the 7th of March, with a thermometer twenty degrees below the freezing point. In the spring of 1872 a large accumulation of these birds took place early in March in the eastern portion of New York. They were present in the forests about Albany, and were taken in such immense numbers, that the markets of New York and Boston were very largely supplied with them. They are capable of propelling themselves in long-continued flights, and are known to move with an almost incredible rapidity, passing over a great extent of country in a very short time. It is quite a common and well-ascertained fact that pigeons are captured in the State of New York with their crops still filled with the undigested grains of rice that must have been taken in the distant fields of Georgia or South Carolina, apparently proving that they must have passed over the intervening space within a very few hours. Audubon estimates the rapidity of their flight as at least a mile a minute. They are said to move in their flight by quickly repeated flaps of the wings, which are brought more or less near to the body, according to the degree of velocity required. During the love-season they often fly in a circling manner, supporting themselves with both wings angularly elevated. Before alighting, they break the force of their flight by repeated flappings. Their great powers of flight, and the ability thus given to change at will their residence, and their means of renewing a supply of food, are also thought to be

PASSENGER PIGEON.

* Jerdon: "Birds of India," Vol. III., p. 455. † "History of North American Birds," Vol. II., p. 370.

seconded by a remarkable power of vision, enabling them to discover their food with great readiness. Mr. Audubon states that he has observed flocks of these birds, in passing over a sterile part of the country, fly high in the air, with an extended front, enabling them to survey hundreds of acres at once. When the land is richly covered with food, or the trees well supplied with mast, they fly low, in order to discover the part most plentifully supplied. Several writers who have witnessed the occasionally enormous flights of these Pigeons, have given very full and graphic accounts of their immense numbers, that seem hardly credible to those who have not seen them. Mr. Audubon relates that in 1813, on his way from Henderson to Louisville, in crossing the barrens near Hardensburg, he observed these birds flying to the south-west in greater numbers than he had ever known before. He attempted to count the different flocks as they successively passed, but after counting one hundred and



BRONZE-WING.

sixty-three in twenty-one minutes he gave it up as impracticable. As he journeyed on, their numbers seemed to increase. The air seemed filled with Pigeons, and the light of noonday to be obscured as by an eclipse. Not a single bird alighted, as the woods were destitute of mast, and all flew so high that he failed to reach any with a rifle. He speaks of their aërial evolutions as beautiful in the extreme, especially when a Hawk pressed upon the rear of a flock. All at once, like a torrent, and with a noise like that of thunder, they rushed together into a compact mass, and darted forward in undulating lines, descending and sweeping near the earth with marvellous velocity, then mounting almost perpendicularly in a vast column, wheeling and twisting so that their continued lines seemed to resemble the coils of a gigantic serpent. During the whole of his journey from Hardensburg to Louisville, fifty-five miles, they continued to pass in undiminished numbers, and also did so during the three following days. At times they flew so low that multitudes were destroyed, and for many days the entire population seemed to eat nothing but Pigeons.

"When a flight of Pigeons discovers an abundance of food, sufficient to induce them to alight, they are said to pass around in circles over the place, making various evolutions; after a while passing lower over the woods, and at length alighting; then, as if suddenly alarmed, taking to flight, only to return immediately. These manœuvres are repeated with various indications of indecision in their move-

ments, or as if apprehensive of unseen dangers. During these manœuvres the flapping of their many thousand wings causes a reverberation suggestive of distant thunder. When at last settled upon the ground, they industriously search among the fallen leaves for the acorns and the beech-mast, the rear flocks continually rising, passing over the main body, and re-alighting. These changes are so frequent that at times the whole collection appears to be in motion. A large extent of ground is thus cleared in a surprisingly short space of time, and cleared with a completeness that is described as incredible. They are usually satiated by the middle of the day, and ascend to the trees to rest and digest their food. On these occasions the Pigeons are destroyed in immense numbers, and their abundance in large extents of the country has been very sensibly reduced."

VICTORIA CROWNED PIGEON.

In the fourth division of the Pigeons the tarsus is about equal to the middle toe, or longer, and is bare at the base. The tail is moderate, often short or rather long, but not pointed; the toes are rather slender. Many of these birds frequent the ground, and the colours are more delicate than in the Fruit Pigeons, or in the True Pigeons, which latter have generally an iridescent colour on the sides of the neck. They mostly feed on the ground on grain, pulse, and other small seeds, and are not in general gregarious, though large numbers may be seen feeding together. They chiefly frequent open and cultivated country, a few preferring highly-wooded or forest districts, and many are very familiar birds, feeding close to houses and stables. They nest on low trees or shrubs, constructing the usual slight platform nest, and they breed at all seasons of the year.* Mr. Gould says that the species of *Phaps*, which are popularly known as Bronze-wings, are more widely dispersed in Australia than those of any other member of the family, being universally distributed over the country from north to south, and from east to west; even the parched deserts of the interior are visited by them if a supply of water sufficient for their existence be within reach of their evening flight, which is performed with the most extraordinary rapidity and power. Writing of the common Bronze-wing (*Phaps chalcoptera*), the same writer observes :—"It is a plump, heavy bird, weighing when in good condition fully a pound; and is constantly eaten by every class of persons resident in Australia. Its amazing powers

* Jerdon.

of flight enable it to pass in an incredibly short space of time over a great expanse of country, and just before sunset it may be observed swiftly winging its way over the plains or down the gullies to its drinking-place. During the long drought of 1839–40, when I was encamped at the northern extremity of the Brezi range, I had daily opportunities of observing the arrival of this bird to drink, the only water for miles, as I was assured by the natives, being that in the immediate vicinity of my tent, and that merely the scanty supply left in a few small natural basins in the rocks, which had been filled by the rains of many months before. This peculiar situation afforded me an excellent opportunity for observing not only the Bronze-wing, but many other birds inhabiting the neighbourhood. Few, if any, of the true insectivorous or fissirostral birds come to the water-holes; but, on the other hand, those species that live upon grains and seeds, particularly the Parrakeets and Honey-eaters (*Trichoglossi* and *Meliphagæ*), were continually rushing down to the edges of the pools, utterly regardless of my presence, their thirst quite overcoming their sense of danger. Seldom, if ever, however, did the Bronze-wing make its appearance during the heat of the day, but at sundown it arrived with arrow-like swiftness, either singly or in pairs. It did not descend at once to the edge of the pool, but dashed down to the ground at about ten yards' distance, remained quiet for a short time, then walked leisurely to the water, and, after drinking, winged its way to its roosting-place. With a knowledge, therefore, of the habits of this bird, the weary traveller may always know when he is in the vicinity of water; and, however arid the appearance of the country may be, if he observes the Bronze-wing wending its way to a given point, he may be certain to procure a supply of water. When rain has fallen in abundance, and the rivers and lagoons are filled, the case is materially altered; then the Bronze-wing and many other birds are not so easily procured."

THE THIRD FAMILY OF THE PIGEONS—THE CROWNED PIGEONS.

In this family are placed the large Crowned Pigeons (*Goura*), which inhabit the island of New Guinea and the adjacent islands in the Bay of Geelvink. They are ground-loving birds, remarkable for their large size and the beautiful crest which ornaments the head, and which has gained for them the appropriate name of "Crowned" Pigeons. In their native state they go about the woods in small parties in search of fruit, much after the manner of Pheasants.

CHAPTER VII.

THE GAME-BIRDS.

GALLINÆ. GAME-BIRDS—Characteristics—THE CURASSOWS—The Sub-families—Distinctive Features—Prof. Sumichrast on the Hocco and Penelopes—THE HOATZINS—THE PHEASANTS—THE PEACOCKS—Their Gorgeous Plumage—The so-called Tail—Is the Peacock vain?—Dr. Jerdon's Account of the Habits of the Peafowl—The Peacock Pheasants—The Argus Pheasants—THE TRUE PHEASANTS—Description of the Habits of the Monaul, or Impeyan Pheasant—Coloration of Bird—Habits of the English Species of True Pheasant—Reeves's Pheasant—THE GUINEA FOWLS—Distinctive Features—THE TURKEYS—Characters—Species—Dr. Brewer's Account of the Habits of the Wild Turkey—Migration of Turkeys—THE GROUSE AND PARTRIDGES—THE GROUSE—The Capercailzie—The Black Cock—The Hazel Grouse—The Ptarmigan—Its Summer, Autumn, and Winter Plumage—The Willow Grouse—THE PARTRIDGES—Distribution—The Francolins—The American Partridges—The Californian Quail—The Common Partridge—The Snow Partridges—THE QUAIL—THE SAND-GROUSE—THE HEMIPODES—THE MEGAPODES—Their Large Feet—Distribution—Members of the Family—Brush-Turkey—Mr. Wallace's Account of the Maleo—Cuming's Megapode—Mr. Motley's History of the Species—Gould's Description of the Habits of the Mound-raising Megapode of Australia—Moseley's Note on the Incubation of the Megapodidæ.

FIFTH ORDER OF THE CLASS AVES—GALLINÆ—GAME-BIRDS.

No less than eight distinct families are comprised in this fifth order of birds. The head is small in proportion to the size of the body; the bill is short with a soft skin covering the nostrils; the line of the bill is arched, and the nostrils, generally of large size, are placed low down in the mandible. The feet are always very distinctly scaled. Members of the order of Game-birds vary considerably in size, large forms like the Turkey, and little creatures scarcely larger than a Sparrow, such as Button-quails and Hemipodes, being equally included in the order. They are generally omnivorous, scratching the ground in order to obtain the small worms, insects, and grain, on which they

subsist. Instead of washing themselves in water, the game-birds generally dust themselves in mould or sand. The eggs are numerous, and are generally placed on the ground without any attempt at forming a nest, and as a rule the game-birds are polygamous. When the chickens are hatched they are able to shift for themselves, and are in most respects stronger than the young of other birds.

THE FIRST FAMILY OF THE GAME-BIRDS—THE CURASSOWS (*Cracidæ*).

These birds are found only in the Neotropical regions, being confined to Central and South America. About fifty species are known, and they are divided into three sub-families, the *Cracinæ*,

CRESTED CURASSOW.

or true Curassows; the Guans (*Penelopinæ*); and the Mountain Curassows (*Oreophasinæ*). Many of the Curassows are very beautiful birds, having large curly crests and fleshy knobs on their bills. In colour they are sombre, being black and white, or dusky grey, the only ones at all brightly coloured being some of the females of the genus *Crax*. The following is a translation of Professor Sumichrast's note on the habits of two Mexican species:—

"The Hoeco (*Crax alector*) is called the Royal Pheasant by the Mexicans. It is very common in the large forests of the eastern coasts, and in Yucatan, but it does not appear to live on the western slope of the Cordilleras, or, at least, I have never seen it there, and the inhabitants could tell me nothing positive on this subject. These birds are usually to be seen in couples or in little companies, at least at one time of the year they are thus to be observed. They are less fierce than the Guans; and they are to be seen more often walking about on the ground, and during the dry season, that is to

say, during the months of March, April, and May. They are very fond of rolling themselves in the dust, like game-birds in general. Their principal food consists of small worms, various seeds, and wild fruits. The males commence to seek the females from the month of January, and the time of love lasts until the end of March. The males are heard calling out in the woods with a loud and strong cry, and uttering a sound which can be best described as *baoūm-baoūm*. At this season the pursuit of the Hocco becomes very easy, the reason being that with them their amatory desires are much greater than their instinct of preservation, so much so that they lose all foresight, allow themselves to be approached closely, and do not trouble themselves much about what is passing around them. Sometimes several males surround a female and do not desert her even though they perceive the hunter. When we come across one of these little groups collected together in the cause of love, were it possible to kill the female at the first blow, it would be seen that the males rarely take flight; on the contrary, they remain in a state of stupor at the side of the body of the female, and do not disperse till another discharge attacks them. The little fear that man inspires in these game-birds is, without doubt, the reason they are so easily tamed. I can never understand why this bird is not an inhabitant of the poultry-yard like the Turkey, for it is certainly suited for a domestic state, and the adults, although taken wild, soon become tame; the young ones carried away from the nest, or hatched by the mother bird, become as familiar as chickens, and even more so, as they allow themselves to be caressed, and even take their food from the hand of man. It must be that the natives have found the Turkey, which is a bigger bird, sufficient for their wants, or discovered that the Hocco does not multiply easily under the conditions of a domestic life. This bird builds its nest on the trees, and is never very productive. In March the couple construct on a high tree a thick nest of twigs; the female deposits only two eggs, which she takes about a month to hatch. The little ones, once hatched, do not leave their nest till they know how to fly, as likewise do the game-birds, who nest on the ground, but the parents bring them worms and insects. As soon as they begin to know how to use their wings, which is about the end of April, the whole family goes off to seek their fortune, and in quest of ripe fruits, such as chicazapoles, and different kinds of oranges, &c. Wild oranges seem to have a special attraction for them, and in the narianjales, or places in the forests where the tree grows which bears them, the Hocco is generally to be found. In the same forests in hot countries where the Hocco is met with live also the Penelopes, who are even still more common: these are named Cojolites by the Indians. Their manners much resemble those of the Hocco; they make their nest and follow the incubation in the same manner; they, however, sometimes lay three eggs. They live also in large companies, are more mistrustful, perch more, and utter a great many cries. During the day these birds keep themselves in the interior of the forests looking for fruits; morning and evening they approach the border of the woods, crying out very loudly, and several at a time; it is on this account the Spaniards call them Squalling Pheasant. The flesh of the Penelopes is more tender, less dry than that of the Hocco, and, for this reason, esteemed more choice. It is said that their bones, cooked or raw, are a poison for dogs. I must, however, say I have never been able to prove the truth of this surprising fact. To the species Penelopes should be also added another called by the Indians 'Tchitchalaque,' which is found in still greater abundance. This one also lives in families, leads the same kind of life, and is still less fierce. It is to be feared that all kinds of these game-birds will end gradually by growing very scarce, for the excellence of their flesh as food will make them a constant prey to the hunter; and this will be more the case as the Continent of America becomes populated. The facility with which they are shot, joined to their slight increase, will form a rapid cause for their destruction in the future, happily still distant, when the grand forests will disappear from Mexican soil."

The third sub-family of the Curassows contains only the single genus *Oreophasis*, represented in its turn by only one species, the Mountain Curassow (*Oreophasis derbianus*), an inhabitant of Guatemala, in Central America. In the latter country it is very rare, and confined to narrow limits, being found on the mountains between 7,000 and 11,000 feet above the sea-level. The first specimen was in the collection of the fourteenth Earl of Derby, after whom it was named.

THE SECOND FAMILY OF THE GAME-BIRDS—THE HOATZINS (*Opisthocomidæ*).

The position of the singular bird, which is the sole representative of this family, has been a source of some speculation with systematic naturalists, but since its osteology and general anatomy have

been studied more completely, it is now generally admitted that the Hoatzin is a game-bird, and yet exhibits certain affinities to the Touracoes (*Musophagidæ*). The scientific name of the Hoatzin is *Opisthocomus cristatus*, and it is an inhabitant of Guiana and the Amazon region, where it assembles in large flocks. It nests in the lower part of a tree, the eggs being three or four, white, spotted with reddish tint.

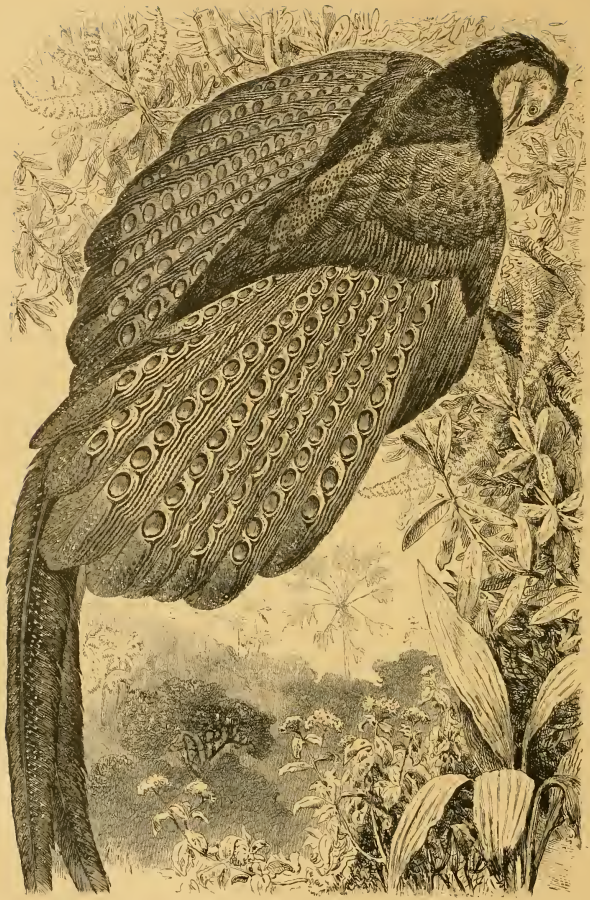
THE THIRD FAMILY OF THE GAME-BIRDS—THE PHEASANTS (*Phasianidæ*).

The present family includes some game-birds differing in appearance, such, for instance, as the Peacocks, the Jungle-fowl, and the Guinea-fowl: in fact, Mr. D. G. Elliot, the author of a large work on the subject, recognises no less than eight sub-families, including also the Turkeys among the number. Three sub-families may easily be recognised—the Peacocks (*Pavonina*), with their elongated tails, and general tendency to an "ocellated" plumage, exhibiting the large rounded metallic spots, or "ocelli," which are so marked a feature in the Peacocks and Argus Pheasants; secondly, the true Pheasants (*Phasianinæ*); and thirdly, the Guinea-fowls (*Numidinæ*).

THE FIRST SUB-FAMILY OF THE PHASIANIDÆ, OR PHEASANTS. THE PEACOCKS (*Pavonina*).

The true Peacocks are Asiatic birds, and in some parts of India are very abundant, being, as a rule, unmolested by the natives, who have a great dislike to their being killed. Large flocks may, therefore, often be seen; and the birds are described by Indian naturalists as being even more beautiful in a wild state than they are in a domesticated condition, though it is well known what an ornament they are in gardens. Scarcely anything more gorgeous can be met with in the whole range of bird-life than a male Peacock in full plumage; and the bird seems to be conscious of the admiration he excites, when he displays his long plumes, and gently rustles them, to give effect to the beautiful "eyes," or "ocelli," which ornament his train. The long feathers which he expands in the shape of a fan are not, as is so often stated, the Peacock's tail; but are simply the upper tail-coverts prolonged to a prodigious extent: the true tail-feathers being very much shorter, and serving, when spread, as a support to the fan-like disc, which constitutes so splendid an attraction in these birds. As a rule, however, the stigma which attaches to the Peacock of being a vain bird—a saying quite proverbial—is scarcely deserved, as the bird is no more vain than any other game-bird at the season of love. It is to his mate that the Peacock generally shows himself off to the best advantage; though at the sight of another male displaying his tail the bird will often commence to spread his own plumes. That the object is to endear himself to the female is seen by the way in which he walks slowly in front of her, turning when she turns, and gently quivering his fan as if to attract her attention; and it is not an unusual sight to see three or four birds in the Zoological Gardens of London displaying themselves at one and the same time.

"The Peafowl," writes Dr. Jerdon, "inhabits the whole of India proper, being replaced in Assam, and in the countries to the east, by another species. It frequents forests, and jungly places, more especially delighting in hilly and mountainous districts; and in the more open and level country, wooded ravines, and river banks are the never-failing resorts. It comes forth to the open glades and fields to feed in the morning and evening, retiring to the jungles for shelter during the heat of the day, and roosting at night on high trees. It ascends the Neilgherry and other mountain regions in Southern India to 6,000 feet or so of elevation; but it does not ascend the Himalayas, at all events in Sikkim, beyond 2,000 feet. In many parts of the country it is almost domesticated, entering villages, and roosting on the huts, and it is venerated by the natives in many districts. Many Hindoo temples have large flocks of them; indeed, shooting it is forbidden in some Hindoo states. The Peafowl breeds according to the locality; from April till October generally in Southern India; towards the close of the rains laying from four to eight or nine eggs in some sequestered spot. The Peacock, during the courting season, raises his tail vertically, and with it, of course, the lengthened train, spreading it out and strutting about to captivate the hen birds; and he has the power of clattering the feathers in a most curious manner. It is a beautiful sight to come suddenly on twenty or thirty Peafowls, the males displaying their gorgeous trains, and strutting about in all the pomp of pride before the gratified females. The train, of course, increases in length for many years at each



ARGUS PHEASANT.

COMMON PHEASANT.

successive moult; but it appears to be shed very irregularly. Though it cannot be said to be a favourite with sportsmen in India, few can resist a shot at a fine Peacock whirring past when hunting for small game. Yet Peachicks are well worth a morning's shikar for the table, and a plump young Peahen, if kept for two or three days, is really excellent. An old Peacock is only fit for soup."

A bird merely winged will often escape by the fleetness of its running. They generally roost on particular trees, and by going early or late to this place they can readily be shot. Peafowl are easily

PEACOCK PHEASANT.

caught in snares or common hair nooses, and are generally brought in alive for sale in numbers in those districts where they abound. In confinement they will destroy snakes and other reptiles, and in their wild state feed much on various insects and grubs, also on flower buds and young shoots, as well as on grain.

In the same sub-family are to be found the Peacock Pheasants (*Polyplectron*), which inhabit the eastern Himalayas and the mountains of the Indo-Malayan islands. In colour they are brown, as a rule, but the tail has a number of green or purple spots, like the "ocelli" of a Peacock, and this peculiarity has gained for them the popular title of "Peacock" Pheasants. Finally, with the Peafowl must be placed the magnificent Argus Pheasants, of which there are two species known, the common Argus from Malacca, and the Gray's Argus from Borneo. In its wild state the Argus Pheasant is seldom or never seen, but it is frequently trapped by the Malays, who set springs in the woods where they see the track of a Pheasant, and thus capture not only the Argus but all sorts of

birds, Fire-backed Pheasants, Ground Cuckoos, and even Pittas, or Ant-Thrushes. Within recent years the Argus has been successfully brought over to Europe, and has even bred in the Zoological Gardens, though the eggs have to be hatched under a domestic fowl, as the female does not always show a disposition to sit. The number of eggs in confinement appears to be two, and the young have proved to be excessively difficult to rear. Two, however, lived for some time in the Zoological Gardens in the Regent's Park, and the male chick could be recognised from the female at an early stage by his larger size and brighter colour. They begin to fly very early, and when only four or five days old could mount a high perch, and rest under the wing of the old bird.

THE SECOND SUB-FAMILY OF THE PHASIANIDÆ, OR PHEASANTS.
THE TRUE PHEASANTS (*Phasianinæ*).

This is much the largest of the three sub-families, and contains all the Impeyan Pheasants, or Monauls, the Firebacks, and the Pheasants proper, of which the Common Pheasant is a type, and indeed all the members of the family not included in the Peacocks or the Guinea-fowls. By far the most splendid of this group of Pheasants are the Monauls (*Lophophorus*), which inhabit the hill-ranges of the Himalayas and Assam, as far east as western China, but always high up in the mountains. An excellent observer, under the signature of "Ornithognomon," has given a very good account of this Impeyan Pheasant, or Monaul of the Himalayas :—

"The Monaul ranges high in the mountains, where it is found keeping near the line of snow, and, although met with in the ridges next the plains, becomes much more numerous farther in the mountains. It frequents the entire range of the Himalaya, from Afghanistan to Sikkim, but does not extend along the great branch running south through Burmah and Malayana. Its range in elevation varies according to season ; but in the severest winter it does not appear to descend below 6,000 feet above sea level. I have seen numbers in Nepaul in winter, brought with other kinds of Pheasants by the Bothias for sale in the plains of India, where they soon perish when the hot weather begins. The gradual increase of our hill stations in the Himalaya, and the unwearying excursions of our sportsmen, are driving these birds from the vicinity of our settlements into the more inaccessible mountains of the interior. Formerly, about Mussouri and Landour, it was not thought a great feat to bag a few in a day's work ; but now they have to be sought much farther. They are forest birds, and difficult to be found in summer, when vegetation is profuse, unless by ascending to the highest limits of the forest, when shots may be obtained in the open downs above, and amongst the rocks and thin herbage near the snow. In autumn, as the underwood decays, they descend and scatter through the woods, sometimes in great numbers, and seek lower levels as the winter advances, and the soil becomes frozen. At such times they draw near to the small villages, perched on the lower spurs and above the sheltered valleys, and seek their food in the fields, where the mountaineers, with their large hoes, have dug up the soil. In these seasonal migrations it has been remarked that the females and young birds descend lowest, and approach nearest to human habitations. The old birds are shyer and wilder, and many remain high up, even where the ground is deeply covered with snow.

"They appear to be either capricious in their rambles through the woods, or are actuated to particular spots at particular times, for reasons not apparent. Sometimes the sportsman will put up in one part of the forest fifteen or twenty in the space of four or five acres. In another portion he may keep on flushing, for the rest of the day, single birds feeding in solitude far apart. At no time are they gregarious ; and whenever alarmed, they rise and escape independently of each other. In some parts only cock birds are found, in others only hens—and these last, as before remarked, together with young birds, always nearest to habitations, and in opener slopes of the mountains, more accessible to the sportsman. Severity of cold and scarceness of food have their taming effects on the Monaul, as on other birds ; and the lower the snow the easier the task of making a bag. But, in fact, the Monaul is not nearly so wild as the Tragopan, the Euplocamus, the Polyplectron, the Macartneya, and other genera of Pea-fowl and hill Pheasants. Its habits are more open ; and instead of skulking in such impermeable cover as is described in my remarks on *Polyplectron tibetanus* (or Chinquis), it walks about pretty openly in forest glades clear of underwood. At the same time it must be observed that the absence of cover enables it to espy the sportsman at a distance ; and it takes to wing frequently out of shot, which I have never seen any other bird of this family do. When on the

wing, it generally flies a long way, and, if much alarmed, crosses over to a parallel ridge. Occasionally, however, it will settle on the low limb of a tree at no great distance; and once there, it is, like many other gallinaceous birds, easy of access. Sometimes, when approached in open spots, it walks off or begins to move, stopping often and eyeing the intruder, till suddenly, and without apparent immediate cause, it will rise with a startling flapping or flutter of the wings, scattering the dead leaves in a shower around, and fly headlong into the wood with a succession of short piercing shrieking whistles, which appear to act as a warning to some distant companions; for their calls are often heard in reply. When feeding quietly and in security the Monaul has a sweet mellow call, a long plaintive note which it utters from time to time, especially of a morning and after sunset. It has the same melancholy effect on the ear as the creaking whistle of the Curlew, winging his way along the mud-flats as evening settles over the lonely shore. The Monaul breeds towards the end of spring. The courtship is carried on in the chestnut and large timber forests before the birds ascend (during the summer heats) towards the regions of perpetual snow. It is generally near the upper limits of these forests, where the trees are dwarfed and sparingly scattered, that the hen lays and incubates three to five eggs, in a depression on the ground. Whether any nest is made, Dr. Jerdon did not know, but 'Mountaineer' says the female makes one 'under a small overhanging bush or tuft of grass.' The eggs are of a dull cream or pale buff colour, sprinkled with reddish-brown. Like most gallinaceous birds, the Monaul may be said to be omnivorous. 'Mountaineer' says it will not touch wheat and barley, but those kept in confinement ate rice and grain readily, as well as insects, worms, maggots, flesh, lizards, fish, eggs, &c. It is a diligent digger, and the slightly expanded tip of the mandible acts like a hoe or shovel. I had several of these birds in an aviary at Mullye in Sirhoot. They were strong and vigorous as long as the cold weather lasted, and soon became tame, unlike the red Pheasants (*Ceriornis*) purchased at the same time from the Botias passing through the station, which never lost their original wildness, and began to droop about April; whereas the Monauls did not succumb to the atmosphere of the plains till June, when the rains had set in. Unlike the smaller hill Pheasants, they were not pugnacious.

"If shipped off early in the cold weather from Calcutta, these birds could easily enough be transported to England, where the temperature would suit them, if there were any means of giving them shelter during the extreme severity of winter, or of procuring for them in that season a proper substitute for the insect food which never fails them on the lower elevations of the Himalaya. If they could become as thoroughly acclimatised as the common Pheasant, they would indeed be a superb ornament to our parks and plantations, though perhaps no great acquisition to the table. It is many years since I tasted the Monaul, and speaking from memory, the flavour appeared to me much the same as that of the Peafowl, the breast being tender and palatable in the young birds, but no part being fit for anything but soup in old specimens. The Monaul has bred in England both in the Zoological Gardens of London and in the possession of the Earl of Derby, where the female is said to have laid on one occasion thirteen or fourteen eggs."

The Monaul is a splendidly-plumaged species, having on the head a crest of metallic-green plumes like those forming the crown of a Peacock; the neck is purple, shot with green, and in some lights with golden copper; middle of the back white; wings black, the coverts, like the back, glossed with purple and green; rump and upper tail-coverts rather more purple; tail cinnamon; underneath black, the throat glossed with green and purple; naked skin round the eye blue; bill dark horn-colour; legs dull ashy green; eye brown. The length of the bird is about two feet and a half, and as in most of the Pheasants, the hen is much plainer in colour, being brown, varied with black spots and bars; upper tail-coverts white at the end, as also the tip of the tail; chin and throat white.

The true Pheasants (*Phasianus*), to which the English species belongs, are widely spread over the Palæarctic region, and reach their highest development as regards number of species in Central Asia and China, where numerous kinds of true Pheasant are found, all of them more or less like the English bird in appearance. One of the most familiar is the Chinese Ring-necked Pheasant, which is often crossed with the English bird: indeed, this cross-breeding has been carried to such an extent in Great Britain that thoroughly pure-bred birds are becoming rarer and rarer. The original home of the English Pheasant was the neighbourhood of the river Colchis, and hence its specific name of *Phasianus colchicus*, and it is still abundant in its original habitat.

It is doubtful whether the Pheasant would survive in England if left entirely to itself, as it depends a good deal on the amount of artificial food which is supplied to it in preserves, while most of the rearing of the young is entrusted to the care of domestic fowls instead of being left to the protection of the hen Pheasant. The latter has many enemies, and nesting as it does on the ground, runs great risk of being carried off by a prowling fox or cat. The eggs are from ten to fourteen in number, and are of an olive-brown colour; they are placed on the ground, and there is scarcely any attempt at a nest. The sitting-bird is said to be timid, and is frightened off the nest even by such a small thing as a crawling snail, while at any real danger she sinks upon the

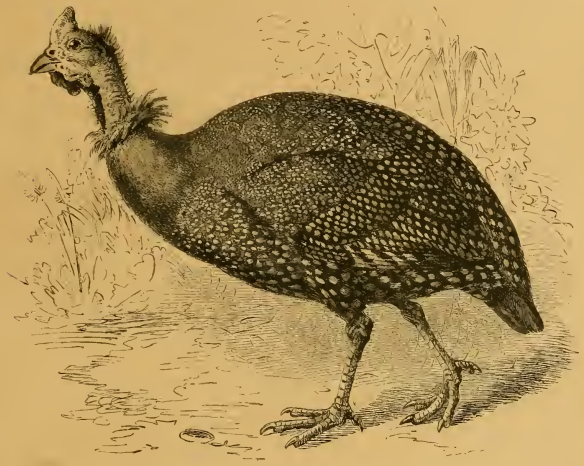
MONAUL, OR IMPEYAN PHEASANT.

nest half dead with fear. Timidity is a great characteristic of the common Pheasant, and even when artificially reared in hen-coops, the young birds never become tame like chickens, but always come for their food in a timid and half frightened manner. As a rule, the Pheasant frequents the thick woods for the purpose of roosting only, as in the daytime it seeks its food, which consists of grain, seeds, green shoots, and insects, among hedge-bottoms and thickets with long grass and tolerably dense undergrowth; it also affects damp ground and osier beds. In the spring the cock bird is often heard crowing, and at that season of the year he comes out from his woodland retreats and is often seen in the open. The Pheasant is polygamous, and is very tenacious of his own domain, driving every other male bird of his species away. At this season his plumage is very beautiful, and the red comb at the sides of his head becomes more brilliant in colour.

The splendid Reeves's Pheasant (*Phasianus reevesii*) must also be mentioned. It is a native of China, and is remarkable for its long banded tail, which often exceeds five feet in length.

THE THIRD SUB-FAMILY OF THE PHASIANIDÆ, OR TRUE PHEASANTS.
THE GUINEA-FOWLS (*Numidinæ*).

The Guinea-fowls are all natives of Africa and Madagascar. They are very similar in plumage, being of a dark-grey colour, covered all over with round spots of white, generally larger on the back and under-surface of the body. The outer quills are white in most of the species, and show conspicuously when the birds are flying. The head is ornamented with a helmet or horny crest in some of the species, whilst others have lappets, and others naked red skin on the face, which gives them a handsome appearance, this being often enhanced by a tuft or top-knot on the crown. In their habits, in a wild state, the Guinea-fowls are not unlike Pheasants, the female, on being disturbed,



GUINEA-FOWL.

flying off and leaving her little ones, who immediately conceal themselves of their own accord. They are found in many parts of Africa in rocky localities amongst ravines and stony places. The flesh is much appreciated for food. The voice of the Guinea-fowl is harsh, as any one must know who has heard the peculiar call of the species. They are extremely shy, and when feeding in the open will speedily scent danger, one first uttering his loud cry *Come back!* and then running a little way, quickly followed by the whole flock, which, after doubling a short distance, will make for the nearest place of safety.

THE FOURTH FAMILY OF THE GALLINÆ, OR GAME BIRDS.
THE TURKEYS (*Meleagridæ*).

By some writers the Turkeys are considered to belong to the Pheasants, of which they form a sub-family, but it seems better to keep them as a distinct family, representing in America the Phasianidæ of the Old World. They are the largest of game-birds, and on that account have been domesticated for a great length of time. Their English name of Turkey is supposed to have been

given them on a supposition of their coming from that country, but they are really inhabitants of America; they were first introduced into England about the year 1541.

All the Turkeys have the head naked, with wattles, or folds, of bright naked skin, which becomes much more brilliant when the bird is excited or angry; they have also a curious tuft of long hairs on the breast. The plumage of the Turkeys is always more or less metallic, and the wild birds are much finer than the domestic race, which does not seem to have improved under the hand of man. There are only three species of Wild Turkey known, the Common Turkey (*Meleagris gallopavo*), the Mexican

OCELLATED TURKEY.

Turkey (*M. mexicana*), and the Ocellated Turkey (*M. ocellata*), the last being a very fine and brilliantly coloured bird with metallic plumage. It is found in Honduras and Yucatan.

"The Wild Turkey," writes Dr. Brewer, "is found throughout Eastern North America from South Carolina northward, and from the Atlantic to Texas and Arkansas. It has probably become an extinct species in New England, though within a few years individuals have been shot in Montague, Mass., and in other towns in Franklin county. The construction of railways, however, and the settlement of the country, have probably led to their final extermination; at least, I have known of none being taken within the limits of Massachusetts for several years. In the unsettled portions of the Western and Southern States, and in the country watered by the Mississippi and the Missouri rivers and their affluents, these birds are comparatively plentiful, though the question of their final extinction is probably only one of time, and that not very distant."

Mr. Audubon, in his very full and minute account of their habits, speaks of them as irregularly

migratory and gregarious, their migrations having reference only to the abundance of food, and their meeting together in the same localities being, to a large degree, caused by the same source of attraction—the supply of mast in certain regions. In this way they desert sections where the supply is exhausted, and advance towards those where it is more plentiful. Late in October these birds assemble in flocks in the rich bottom lands of the Western rivers, the male birds associating in parties of from ten to a hundred, and keeping apart from the females. The latter are simultaneously moving into the same regions, but only in small family groups, each leading its own flock, then nearly grown. These migrations are made on foot, except when they are compelled to cross a stream. On their first coming to the banks of a river they are said to make a pause there of one or two days before they attempt to cross, the old males strutting about up and down the banks, making a loud gobbling, and calling one another, as if to raise their courage to a befitting point. Even the females and the young assume something of the same pompous demeanour, spreading out their tails, running round one another, and making a loud purring noise. At length, after this prolonged preparation for their passage, they all mount to the top of a high tree, and at a signal given by their leader, take flight for the opposite shore. Occasionally some fall in the water, when they bring the wings close to the body, spread out the tail, and plying the legs with great vigour move rapidly towards the shore, where, by a violent effort, they extricate themselves from the water. After thus crossing a stream of any magnitude they are often found in a bewildered state, and fall an easy prey to the hunter. Where their food occurs abundantly they separate into smaller flocks, composed of birds of all ages and sexes. At times they are known to approach farm-houses, associate with the domesticated fowl, and enter the corn-cribs in quest of food, passing the fall and the winter in this manner.

Early in February the love-season is said to commence, the first demonstrations being made by the males, but for some time persistently avoided by the females; at this period the sexes roost apart. When a female utters a call-note the male birds within hearing return the cry, uttering notes similar to those with which the domestic Turkey greets any very unusual sound. If the call-note has been uttered by a female on the ground, the males fly to the place, spreading and erecting their tails, drawing their heads back on their shoulders, depressing their wings with a quivering motion, and strutting pompously about. At the same time they emit from the lungs a succession of very peculiar puffs. On these occasions the males often encounter each other, and desperate contests ensue, which frequently have a fatal termination, caused by furious blows inflicted on the head. When one cock Turkey has thus destroyed its rival, it is said to caress the dead body in an apparently affectionate manner.

When the Turkeys have mated, the alliance is supposed to last for the season, though a male Turkey is often known to have more than a single mate; and the hens are said also to keep apart from the males while they are laying their eggs, for the cock would inevitably destroy them. At the end of the love-season the males become emaciated, and cease to gobble. They then separate entirely from the females, and keep apart by themselves until they recover, when they re-unite in small flocks. The female begins to deposit her eggs about the middle of April, selecting for that purpose a place as much concealed as possible from her many enemies. The nest, always on the ground, consists of a few withered leaves in a hollow scratched out by the side of a fallen log, or the top of a prostrate tree, or under a thicket, or within the edge of a cane-brake, but always in a dry place. The eggs are from ten to fifteen in number, but are sometimes as many as twenty. On quitting the nest the hen bird covers them with leaves. When the young are hatched the old mother shows great solicitude, guarding them carefully from wet, which is injurious to the chicks.

The food of the Turkey in a wild state is stated by the author above quoted to consist of grass, various kinds of plants, corn and other grain, seeds, fruit, and also beetles, small lizards, tadpoles, &c., with a preference for pecan-nuts and wild grapes to any other kind of food. The young usually feed on small berries and insects.

In confinement the Turkey has kept wonderfully close to the colour of the parent stock, but some domestic races are known. In the British Museum is a light-brown race with a large top-knot like a Polish fowl. This same race was figured in a work on birds one hundred and twenty years ago.

CAPERCAILZIE.

THE FIFTH FAMILY OF THE GALLINÆ, OR GAME BIRDS.
THE GROUSE AND PARTRIDGES (*Tetraonidæ*).

The Grouse differ from the Partridges chiefly in their feathered toes, and in having the nostrils shut in by a soft feathered skin, whereas the Partridges have an open nostril and bare legs. None of the members of the Grouse or Partridges have spurs.

THE FIRST SUB-FAMILY OF THE TETRAONIDÆ—THE GROUSE (*Tetraoninæ*).

These birds are entirely peculiar to the northern parts of the Old and New Worlds. In Europe the most familiar species are the Red Grouse, the Ptarmigan, the Hazel Grouse, and, above all, the Black Cock and Capercailzie; whilst in North America, in addition to the White Grouse and Ptarmigan, there are several fine kinds, such as the Pinnated Grouse, the Canada Grouse and others. The Capercailzie (*Tetrao urogallus*) is the largest species which we have in Europe, where it is found most plentifully in the forests of the north; but it is also met with in the pine-forests of Central and Southern Europe, and is known to inhabit the Pyrenees. In the extreme east of Siberia it is represented by a second species (*Tetrao urogalloides*).

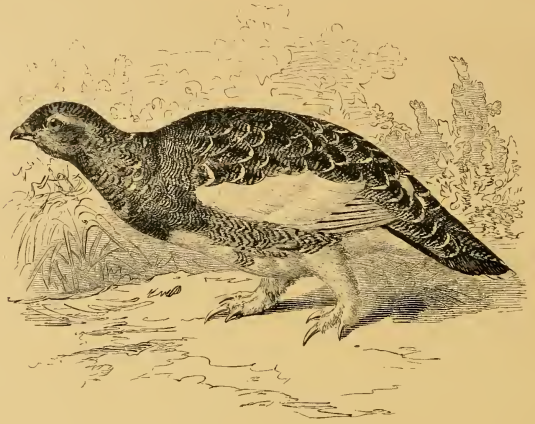
The Capercailzie was never a very common bird in England, and inhabited only the northern parts of Scotland, in which it gradually became extinct. About fifty years ago, an attempt to re-introduce the bird was made by the Marquis of Breadalbane, with such success that in certain districts of Scotland the Capercailzie is now quite plentiful. Numbers of them are exposed for sale during the winter in the London shops, many of them, however, coming from Norway, where the species is common, and a capital account of its habits will be found in Mr. Lloyd's "Game-birds and Wild-fowl of Sweden and Norway." The nest of the Capercailzie is placed on the ground, and from six to twelve eggs are laid by the hen bird, who looks after the rearing of the young, without assistance from the cock. The young ones keep with their mother until the winter commences, the cock birds separating from her before the hens. In spring-time the male Capercailzie begins his *play*, as it is called, like many other Game-birds, for the purpose of attracting the hen birds. Seated on a pine, he starts his love-song, which is kept up the entire day from sunrise to sunset, and while thus engaged he becomes so absorbed in his efforts, that he falls an easy prey to the gunner, who is able to creep up within shooting distance. The same spot is used as a "playing-ground" by the male Capercailzie for a considerable time, if the bird is undisturbed, and several birds may be heard in the same locality at the same time. Fights often take place between the males, and the old birds never allow the young cocks of the preceding year to play on their domain. The cry of the male resembles the words *peller, peller, peller*, increasing in rapidity; and this is replied to by the females within hearing by a sort of harsh croak resembling the words *goet, goet, goet*. While uttering his notes, the cock bird puffs out his plumage and puts himself in extraordinary attitudes.

The length of the Capercailzie is about twenty-eight or thirty inches, the plumage is black, the nape and hind neck deep grey with blackish wavy lines. The under parts are spotted with white, and there is a steel-green shade in the breast: tail black, with white spots. The female is smaller, and is of a sandy-brown colour, barred and variegated with black.

The Black Cock (*Tetrao*, or *Lyrurus tetrix*) is also found only in the Palæarctic region. It is widely spread over Europe, but is replaced in the Caucasus by another species—the Georgian Black Grouse. The beautiful curved outer tail-feathers always serve to distinguish the Black game from the Capercailzie. The Hazel Grouse (*Bonasia betulina*) is another European Grouse, which, however, does not come to England, but is found over Northern Europe and North Asia, and is a pretty bird with a fine crest.

The Ptarmigan (*Lagopus mutus*) is found on the high mountains of Scotland, and throughout the mountainous parts of Europe, but does not occur in America. The present species, according to Dr. Dresser, "inhabits the more elevated, rocky, and barren localities, where it replaces the Scottish Grouse and the Willow Grouse, and it seldom or never descends to the lowlands, where these latter species have their home, unless driven down by stress of weather in search after food. The tracts of ground over which the Ptarmigan is distributed are much more extensive and more inaccessible than those

lowland ranges which the Red Grouse and Willow Grouse frequent; and hence the present species appears somewhat less numerous than the latter bird. Should an intruder make his appearance in the home of the Ptarmigan, or should a bird of prey appear, they squat and remain motionless, trusting chiefly to the similarity of their plumage to the ground and the herbage to enable them to escape unseen. Should one utter his croaking note, he is generally on a stone ready to take wing at a moment's notice, and when he rises and calls all the rest of the covey join him. So close do they squat, and so well does their plumage harmonise at all seasons of the year with the surroundings, that one may walk through a covey without being aware of the close proximity of a single individual. In the month of July, according to Maegillivray, and in October, according to Barth and other Scandinavian naturalists, the Ptarmigans begin to collect in packs, and are found in lower altitudes than in

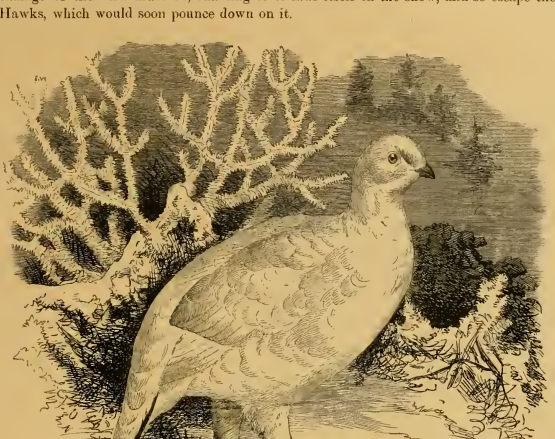


PTARMIGAN IN SUMMER PLUMAGE.

the summer season. Barth says they do not unfrequently visit the sea-coast, and, being white, are very conspicuous; they appear quite bewildered, and easy to approach within gunshot, whereas, when the ground is covered with snow, they are shy and take wing before one has arrived within anything like gunshot range. They fly tolerably swiftly, in a loose irregular body, their mode of flight resembling that of the Red Grouse, and when once on the wing, will generally fly some distance before settling. Their call note is a harsh croak, not unlike the croak of a frog, and it is frequently uttered as an alarm call. The food of the present species consists chiefly of the tender twigs and leaves of *Empetrum nigrum;* but Maegillivray says that the crops of specimens he examined contained a large quantity of fresh green twigs of *Calluna vulgaris, Vaccinium myrtillus,* and *Empetrum nigrum,* the largest fragments not exceeding five-twelfths of an inch in length. Leaves and twigs of *Vaccinium vitis-Idæa, Salix herbacea,* seeds of various *Juncæ* and *Cyperaceæ,* and other plants, with berries in autumn, also form part of their food, the same as that of the Red Grouse. The Grey Ptarmigan, then, is a bird which, feeding on vegetable substances, containing comparatively little nourishment, introduces a large quantity at a time, like a ruminating quadruped, and gradually digests it while reposing."

In summer the Ptarmigan puts off his white dress and becomes dark-coloured, not unlike a Willow

Grouse, so that its plumage, assimilating to the colour-tints of the country which it inhabits, proves a protection to the bird. In autumn, however, when the abundance of mosses and lichens gives a grey appearance to the country, the dark-plumaged Ptarmigan would be a conspicuous object; but here again a protective resemblance occurs in the plumage, which in the autumn partakes of an ashy grey shade. In winter, also, when the snow covers the ground, even the Ptarmigan in his autumn livery would be easily seen, and therefore one can understand how great a protection the snow-white plumage of the bird must be, enabling it to hide itself in the snow, and so escape the prying eyes of Hawks, which would soon pounce down on it.



PTARMIGAN IN WINTER PLUMAGE.

The Willow Grouse (*Lagopus albus*) is very similar in plumage to the Ptarmigan, and, like that species, is white in winter, and darker-plumaged in summer. It inhabits Scandinavia, and stretches not only throughout Northern Europe and Siberia, but even extends across the northern part of the New World. In England it is represented by the Red Grouse, which, however, does not put on a white winter dress. The following particulars about the habits of the Willow Grouse are derived from a paper by Mr. Barth on the subject:—The present species is found only where the birch tree is abundant; and plains where only the dwarf birch and willow are found are not suitable to it, as it cannot live in localities where the cover is poor, but requires birch thickets; thus it is rare or common according as the birch growth is distributed. Tracts where larger birch woods and birch thickets are found alternately, with juniper scattered here and there, are its favourite haunts; for there it finds good cover during the seasons when it is changing its plumage. The female deposits from eight to eighteen and even twenty eggs, early or late, according to the elevation inhabited by the bird. Mr. Barth found newly-hatched young in July, and eggs as late as the middle of August. The young birds can

fly when eight days old, at which age they are about as large as a Lark. The parent bird tends them with the greatest care, and when surprised with them will not desert them, but may often be approached near enough to be knocked down with a stick. When about four weeks old the young are as large as a Plover, and are then considered old enough to be shot. They lie very close, and scatter after being flushed, and are then easily procured with the aid of a good dog. In August they grow very quickly, and by the end of the month they are full grown. It appears that when small they not unfrequently lose their parents, but are then taken care of by others; and often as many as thirty individuals of various ages are found in one covey. Until late in September, the coveys remain in the localities where they have bred, and can be approached; but later than that, they pack and resort to the mountains, and gradually get into regions where the true growth ceases. They are then unapproachable, and a quick shot only can get an odd bird out of a pack of about five hundred. Mr. Barth speaks of a pack of about three thousand individuals which he saw between the 3rd and 10th of November. Curiously enough they are sometimes much less shy than at others; and Mr. Barth cannot account for this, except that the weather may to some extent be the cause. He remarks that during the winter they not unfrequently feed at night, and from the middle of March to the middle of April they are to be found in the morning and afternoon in the tops of the birches feeding on the buds. About the middle of March they pair, and commence to drum when in packs of several hundred individuals, but some scatter to their respective breeding haunts, where they live in pairs. The males, however, are more numerous than the females, those which remain unmated ranging about in flocks; and Mr. Barth met with one of about forty individuals on a small island, and shot fifteen out of them, it being considered quite correct to shoot these even during the breeding season.

THE SECOND SUB-FAMILY OF THE TETRAONIDÆ—THE PARTRIDGES (*Perdicinæ*).

All the Partridges have the legs bare and the nostrils naked, with a small operculum, or horny skin, on the upper margin. They are found nearly all over the world, the Pacific Islands alone not possessing any member of the sub-family. In Africa and in India the Francolins constitute one representative of the Partridges; and one species, the common Black Francolin (*Francolinus vulgaris*), is found in Asia Minor and other countries of the Mediterranean basin, extending across Persia to India. The Francolin is a very handsome bird, and, although banished from Sicily, it is by no means uncommon in Cyprus, and still more so in Palestine and Asia Minor.

In America, the Partridges are called Odontophores, or, more familiarly, American Partridges, and they are distinguished by the notches in the mandibles of the bill; the latter also is higher, and more arched than in the Old World species. The following note on one of the largest of the Odontophores is given by that excellent observer, Prince Maximilian of Neuwied:—"It is called 'Capueira' by the Brazilians. Its habits and mode of life are very similar to those of the Hazel Grouse or Gelinotte of Europe (*Bonasia betulina*). It never frequents the open country, but confines itself entirely to the thick woods. In the early part of the year the Capueira lives in pairs, and after the breeding season the families remain in coveys of from ten to sixteen or more in number. These birds run very quickly, and procure their food among the dry leaves on the ground in the midst of extensive woods. The stomachs of such as I examined contained fruits, berries, insects, small stones, and a little sand. The part of the country in which I met with them is the eastern portion of Southern Brazil, from Rio de Janeiro to 13° S. lat.; by Spix they appear to have been found still farther north. In the vast forests bordering the rivers Mucuri, Alcobaça, Belmonte, and Ilheo, they were very common, and we frequently killed them for the sake of the flesh, which was excellent. Their loud and remarkable voice is heard only in the forests, where it reverberates to a great distance. Azara states that the cry is uttered by both sexes, but I believe it is emitted by the male only. Like the domestic cock in Europe, it frequently aroused us at the break of day, bidding us, as it were, continue our researches among the grand, but almost impenetrable, forests of that country. They commenced calling before daybreak, thus affording us ample time for breakfasting, and enabling us to start by the dawn of the young day."

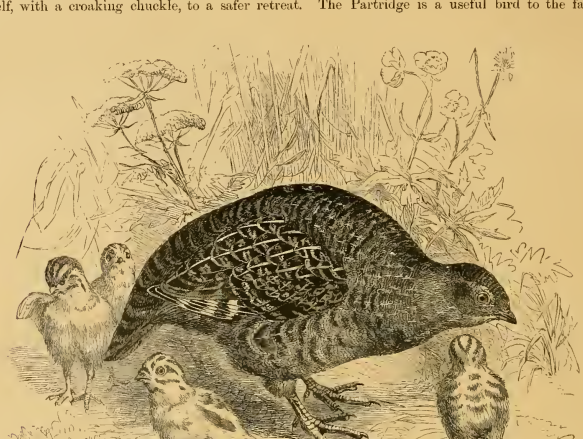
Some of the American Partridges are familiar in parts of Britain, such as the Virginian Quail (*Ortyx virginianus*) and the Californian Quail (*Lophortyx californianus*), attempts having been made, on more than one occasion, to introduce these birds as game into England; while

they are to be seen alive in most of the Zoological Gardens of Europe. The Californian Quail is not only remarkable for the beautiful crest which adorns the head, but also for the rich admixture of colour in its plumage. It is very plentiful in California, being found, according to Dr. Gambel, in swarms, which inhabit not only the woods, but also bushy plains and hill-sides, these flocks sometimes numbering a thousand individuals. As many as fifteen eggs are laid, and the same observer once found twenty-four in a nest, which he supposed to have been the produce of two hen birds. The nest is placed on the ground, usually beneath a bush or at the foot of a tree, the eggs being placed in a hollow, and generally covered with a few leaves or a little dried grass.

CALIFORNIAN QUAIL.

The Common Partridge (*Perdix cinerea*) is widely spread over Europe, being replaced in Eastern Siberia by the Bearded Partridge (*Perdix barbata*). Unlike the Pheasants or the woodland-loving Grouse, the Partridge prefers the open ground, and runs, thereby, considerable risk in the rearing of its brood, should the season be wet and unfavourable to the little ones; hence it arises that the plenty or scarcity of this game-bird depends greatly upon the summer during which the nesting has been in progress. The eggs are often placed in a very exposed situation, and a considerable number of young birds are never hatched, owing to the accidents which overtake the sitting bird during the season of incubation at the jaws of a prowling fox or cat. Any apparent carelessness, however, on the part of the bird as regards her eggs, is amply compensated by the care and courage with which the old bird defends the brood if raised successfully. A nestling Partridge is a beautiful little creature, and has a knack of concealing its small body in the grass in such a successful manner, that if once the observer takes his eye off the bird, he will have great difficulty in re-discovering the object of his search. If suddenly startled off her nest, the old bird will feign lameness, or drop as if wounded, while her warning croaks as she flies off are probably a signal to the chicks to conceal themselves. When once able to fly, the young keep with the old birds in coveys, and evince great

affection for particular spots of ground, so that in shooting Partridges it often happens that a covey, when disturbed, will fly to an adjoining field, and being roused a second time from their retreat, will fly back again to their original starting-point; and this manœuvre the writer has seen repeated more than once by the same covey, until the continued havoc caused by the guns would force the survivors to fly farther away for safety's sake. So closely does the plumage of the Partridge assimilate to the stubble on the ground, that it is an impossibility to see the birds as they sit; and the first intimation of their presence is generally the "whirr" of the rising bird, as he betakes himself, with a croaking chuckle, to a safer retreat. The Partridge is a useful bird to the farmer,



COMMON PARTRIDGE.

feeding on slugs to a large extent, caterpillars, and grubs, so as entirely to counterbalance any little injury that it may do to the corn-fields.

The finest representatives of the Partridge are, undoubtedly, the Snow Cocks or Snow Partridges, which are found in the mountains of Asia Minor, the Caucasus, Altai Mountains, and the Himalayas, and high ranges of Tibet. The following account of the habits of the Himalayan Snow Partridge (*Tetraogallus himalayensis*) is from the pen of Mr. Wilson, better known as "Mountaineer":—

"It is confined exclusively to the snowy ranges, or the large spurs jutting from them, which are elevated above the limits of forest, but is driven by the snows of winter to perform one, and, in some places, two annual migrations to the middle regions. In summer they are only seen near the limits of vegetation. In Koonour (Kunawur) they are common at all seasons, from Chunee upwards; but on the Gangetic Hills, from June till August, however much a person wanders about on the highest accessible places, but few are met with, and I have no doubt whatever but that

nearly all which at other seasons frequent this part, retire across the snow into Chinese Tartary to breed. About the beginning of September they are first seen near the tops of the higher grassy ridges jutting from the snow and the green slopes above and about the limits of the forest. After the first general and severe fall of snow they come down in numbers on to some of the bare exposed hills in the forest regions, and remain there till the end of March. This partial migration is probably made in the night after the fall of snow, as I have invariably found them in their winter quarters early the next morning. It requires a deep fall to drive them down, and in some mild winters, except a few odd birds, they do not come at all. The birds on each respective hill seem to have a particular spot for their winter resort, to which they return every year the migration is made.

"The Snow Partridge is gregarious, congregating in packs, sometimes to the number of twenty or thirty, but in general not more than five to ten, several packs inhabiting the same hill. In summer the few which remain on our side are found in single pairs generally, but across the snow, when the great body migrate, I almost always, even then, found several together. They seldom leave the hill on which they are located, but fly backwards and forwards when disturbed. The Ring-tailed Eagle is an inveterate annoyer of these birds. Inhabiting such exposed situations, where there is nothing to conceal so large a bird from his sight as he sails along the hill-side above them, they at once arrest his attention, and are driven backwards and forwards by this unrelenting tormentor, all day long. On the appearance of one of these birds—which, fortunately for them, are not very numerous—they seldom wait till he makes a swoop, but on his making a wheel near the spot where they are, immediately fly off to another quarter on the hill. The Eagle never flies after or attacks them on the wing; so that, though he allows them little quietude while near their resort, he only occasionally succeeds in securing one.

"The Jer-Moonal never enters forest or jungle, and avoids spots where the grass is long, or where there is underwood of any kind. It is needless to add that it never perches. During the day, if the weather be fine and warm, they sit on the rocks or rugged parts of the hill, without moving much about, except in the morning and evening. When cold and cloudy, and in rainy weather, they are very brisk, and are moving about and feeding all day long. When feeding they walk slowly up-hill, picking up the tender blades of grass and young shoots of plants, occasionally stopping to snatch up a certain bulbous root of which they seem very fond. If they reach the summit of the hill, after remaining stationary some time, they fly off to another quarter, alighting some distance down, and again picking their way upwards. When walking they erect their tails, have a rather ungainly gait, and at a little distance have something the appearance of a large grey goose. They are partial to feeding on spots where the sheep have been kept at nights when grazing in the summer pastures. These places have been called 'tatters' by the shepherds, and the grass on them keeps green and fresh long after the rest of the hill is quite dry and brown. They roost on the rocks and shelves of precipices, and return to one spot many successive nights.

"The Jer-Moonal is not remarkably wild or shy. When approached from below, on a person getting within eighty or a hundred yards, it moves slowly up-hill or slanting across, often turning to look back, and does not go very far unless followed. If approached from above, it flies off at once, without walking many yards from the spot. It seldom in any situation walks far down hill, and never runs, except for a few yards when about to take wing. The whole flock get up together; the flight is rapid, downwards at first, and then curving so as to alight nearly on the same level. Where the hill is open and of great extent, it is often for upwards of a mile, at a considerable height in the air; when more circumscribed, as is often the case on the hills they frequent in the winter, it is of shorter duration—perhaps merely across or into the next ridge.

"They feed on the leaves of plants and grass, and occasionally on moss, roots, and flowers —grass forms by far the greater portion. They are very partial to the young blades of wheat and barley when it is first springing up, and while it remains short; and should there be an isolated patch on the hill where they are, visit it regularly night and morning. They never, however, come into what may be called the regular cultivation. They are generally exorbitantly fat, but the flesh is not particularly good, and it has often an unpleasant flavour when the bird is killed at a high elevation, probably owing to some of the plants it there feeds upon. Though I have spent many

summers on the snowy ranges, I never found the nest or eggs, but in Tibet I often met with broods of young ones newly hatched. There were, however, several old birds, and probably more than one brood of chicks, so I could form no correct idea of the number in one brood. They are hardy birds, and easily kept in confinement, but though they will eat grain, I doubt if they would live long without an occasional supply of their natural green food of grass and plants. They may be kept with the least trouble in large cages, the bottoms of which, instead of being solid, are made of bars of wood or iron wire, so that the cages being put out on the grass, the birds may feed through the interstices.

"The eggs which have been found by travellers are about the size of those of the Turkey, but, like those of the Grouse, are of a more lengthened form; their ground-colour clear light olive, sparingly dotted over with small light chestnut spots."

THE QUAIL.

The Quails are the smallest of the Partridge family, and are inhabitants of the Old World only; they are, however, widely distributed in all four regions. The species best known is the Common Quail (*Coturnix dactylisonans*), which visits Europe in the summer, when prodigious numbers are

PARTRIDGE AND COMMON QUAIL.

trapped and sold for purposes of food. Waterton mentions the fact of 17,000 specimens being brought to Rome in one day. They are to be found in large quantities on the coast of the Mediterranean, and so abundant are they in the beautiful island of Capri, that it is said from this source the bishops, in olden times, derived a large part of their wealth. The Quail is most rapid in its flight, and performs long and fatiguing journeys. Sunset is the time for active exertions; during the day they remain quite quiet, reserving their energies for the evening, when off they go in quest of food. Their favourite nourishment is insects, but they feed at times on grain and seeds; small stones are also swallowed to facilitate digestion. The habits of the Quail are most unamiable and unsocial, and generally when they meet with one of their own species they display a very pugnacious disposition. The female has a much better nature; she is a most excellent mother, even protecting young birds who have been deprived of their parents' care. She builds her own nest of small portions of plants, and lays eight to fourteen eggs; these are pear-shaped in form, of a light brown colour marked with a darker shade. The young are full-grown at six weeks old, and are ready to join their parents in their long autumn journey, which extends as far as the Cape of Good Hope, where they arrive in very large numbers.

The Quail, unlike the Partridge, has several wives, and displays great spirit in keeping rivals at a distance; while the mother is attending to her young ones, the male amuses himself in the vicinity with his companions. The flesh of this bird is esteemed a great delicacy, and the inhabitants of the warm climates, which are periodically visited by the Quail, look forward to its arrival with anxiety.

The length of the Quail is about seven inches and a half, and the general colour is brown, varied with buff streaks on the upper surface. The throat is reddish, and above the eye a buffy-white line passes along the sides of the crown and down the sides of the neck across the throat; the under surface is buffy. In the female the colours are not so bright, and the reddish colour on the throat is absent.

THE SIXTH FAMILY OF THE GAME BIRDS.—THE SAND GROUSE (*Pteroclidæ*).

The Sand Grouse are a group of birds which bear considerable relations to the Pigeons, and in India are often called "Rock Pigeons" by the English sportsman. They are inhabitants of desert countries as a rule, being found over Africa, in Madagascar, the Mediterranean region, Central Asia, and in the Indian Peninsula. Their favourite haunts are desert, open plains, and bare fields with no traces of cultivation; they live generally in large packs, and are rather shy, being quickly on the alert, and evading capture in a most clever manner. They find a valuable aid in their plumage, which is nearly the exact shade of the ground on which they rest, and which renders them almost invisible to the hunter. They squat down at his approach, and when he seems coming too close, fly off at an immense pace. Their flight is very rapid, and they make a peculiar sound with their wings. Their habits seem very regular in the manner of feeding, and morning, noon, and evening, large quantities assemble to drink at the rivers or tanks of water, and the sportsman can quite count on seeing thousands if he should come at one particular time. Their food consists of hard seeds, as well as little insects, &c., which they procure in the same way as the Pigeons or Partridges. Although the Sand Grouse live in such large companies, they are not polygamists; they, however, have frequent battles with their own species, particularly at the breeding season. This season varies according to locality: in the Deccan and Southern India it takes place from December to May; in Central India, later still; and in North Africa, at the English spring. The female lays in a small hollow scraped in the sand, in which she deposits three or four eggs, which are of a greenish stone-colour, spotted closely with grey and brown. The male bird assists in attending to the wants of the little ones, and when arrived at maturity, all fly off together. It is quite possible to keep the Sand Grouse in captivity, and they are a great ornament to the aviary. Their flesh is good eating, if kept long enough; at first it is rather hard and tough, but that of the young birds is delicious, and is much prized. Their habit of squatting in close proximity to one another leads to the sportsman frequently bagging a number of specimens, should he be so fortunate as to creep up within shooting distance.

THE SEVENTH FAMILY OF THE GAME BIRDS.—THE HEMIPODES (*Turnicidæ*).

These are some of the smallest Game-birds known, many of the species not being as much as six inches long. They are found in Africa, India, the Malayan region, extending to China, and

Australia, while one of them, the Andalusian Hemipode, which is an inhabitant of Southern Europe, has even occurred in Great Britain. They are easily distinguished, by the absence of a hind toe, from the smaller Quails of the genera *Coturnix* and *Excalfactoria*. Writing of the Black-breasted Bustard Quail (*Turnix taigoor*), Dr. Jerdon observes that in India it "affects grassy patches in the forests and jungles, also low bushy jungle, and is frequently to be found in the fields of chilli and dhâl, and in various dense crops, especially if near patches of jungle; for in open or barren country, or very highly-cultivated country without jungle, it is comparatively rare. Occasionally small bevies of five or six are flushed together, but in general it is put up singly, or two or three birds together. It feeds on grain of various kinds, but also very much on small insects, larvæ of grasshoppers, and the like. The female has a peculiar loud purring noise. The hen birds are most pugnacious, especially about the breeding season, and this propensity is made use of, in the South of India, to effect their capture. For this purpose a small cage with a decoy-bird is used, having a concealed spring compartment, made to fall by the snapping of a thread placed between the bars of the cage. It is set on the ground in some thick cover, carefully protected. The decoy-bird begins her loud purring call, which can be heard a long way off, and any females within earshot run rapidly to the spot, and commence fighting with the caged bird, striking at the bars. This soon breaks the thread, the spring-cover falls, ringing at the same time a small bell, by which the owner, who remains concealed near at hand, is warned of a capture, and he runs up, secures his prey, and sets the cage again in another locality. In this way I have known from twelve to twenty birds occasionally captured in one day, in a patch of thick bushy jungle in the Carnatic, where alone I have known this practice carried on. The birds that are caught in this way are all females, and in most cases are birds laying eggs at the time, for I have frequently known instances of some eight or ten of those captured so far advanced in the process as to lay their eggs in the bag in which they are carried before the bird-catcher had reached my house. The eggs are said to be usually deposited under a bush in a slight well-concealed hollow; they are from five to eight in number, and of a dull stone-grey, or green colour, thickly spotted and freckled with dusky spots, very large for the bird, and very blunt. In the Carnatic this bird breeds from July to September; farther south from June to August, and in Ceylon, says Layard, from February to August. The females are said by the natives to desert their eggs, and to associate together in flocks, and the males are said to be employed in hatching the eggs, but I can neither confirm nor reject this from my own observation." *

THE EIGHTH FAMILY OF THE GAME BIRDS.—THE MEGAPODES (*Megapodidæ*).

The name Megapode is derived from two Greek words, signifying that the birds have large feet; and in proportion to the size of the bird the foot is, indeed, very big and powerful, being employed for scratching together the earth and rubbish, in heaps of which the eggs are deposited by the Megapode. The members of the family are distributed over Australia, the Papuan Islands, extending throughout the Moluccas and Celebes to Borneo and the Philippines, while an outlying species is found to inhabit the Nicobars. The largest of them all are the Brush-Turkeys (*Talegallus*) of Australia and New Guinea, the Australian species (*T. lathami*) having been acclimatised in Europe, so that in the Zoological Gardens the birds may not only be seen in a state of nature, but there are generally one or two of their mounds to be seen also. The members of the genus *Talegallus* have wattled skin on the head and neck, whence their supposed resemblance to a Turkey has gained for them the familiar name of Brush-*Turkey* from the Australian settlers. As a rule, the colouring of the Megapodes is sombre, being generally brown or black, the only exception being the Maleo bird of Celebes, which has a curious knob on the head, while the breast is light-pink in colour. Of this bird Mr. Wallace gives the following interesting account:—

"In the months of August and September, when there is little or no rain, the Maleos come down in pairs from the interior to one or two favourite spots, and scratch holes three or four feet deep, just above high-water mark, where the female deposits a single large egg, which she covers with about a foot of sand, and then returns to the forest. At the end of ten or twelve days she comes again to the same spot to lay another egg, and each female bird is supposed to lay six or eight eggs during the season. The

* "Birds of India," Vol. II., p. 597.

MALEO. AUSTRALIAN MEGAPODE. BRUSH TURKEY.

male assists the female in making the hole, coming down and returning with her. The appearance of these birds when walking on the beach is very handsome. The glossy black and rosy white of the plumage, the helmeted head, and elevated tail, like that of the common fowl, give a striking character, which their stately and somewhat sedate walk renders still more remarkable. There is hardly any difference between the sexes, except that the casque or bonnet at the back of the head, and the tubercles at the nostrils, are a little larger, while the beautiful rosy salmon-colour is perhaps deeper in the male bird; but the difference is so slight that it is not always possible to tell a male from a female without dissection. They run quickly, but when shot at or suddenly disturbed take wing with a heavy noisy flight to some neighbouring tree, where they settle on a low branch; they probably roost at night in a similar situation. Many females lay in the same hole, for a dozen eggs are often found together, and these are so large that it is not possible for the body of the bird to contain more than one fully-developed egg at the same time. In all the female birds which I shot," continues this author, "none of the eggs besides the one large one exceeded the size of peas, and there were only eight or nine of these, which is possibly the extreme number a bird can lay in the season.

"Arrived at our destination, we built a hut, and prepared for a stay of some days, I to shoot and skin Maleos. The place is situated in the large bay between the islands of Limbé and Banca, and consists of a steep beach more than a mile in length, of deep, loose, and coarse black volcanic sand, or rather gravel, very fatiguing to walk over. It is in this loose black sand that those singular birds, the Maleos, deposit their egg.

"Every year the natives come for fifty miles round to obtain these eggs; which are esteemed a great delicacy, and when quite fresh are indeed delicious. They are richer than hens' eggs, and of a fine flavour; each one completely fills an ordinary tea-cup, and forms, with bread or rice, a very good meal. The colour of the shell is a pale brick-red, or very rarely pure white. They are elongate, and very slightly smaller at one end, from four to four and a half inches long, by two and a quarter and two and a half wide."

After the eggs are deposited in the sand they are no longer cared for by the mother. The young birds, on breaking the shell, work their way up through the sand, and run off at once to the forest. "I was assured by Mr. Duivenboden, of Ternate," says Wallace, "that they can fly the very day they are hatched. He had taken some eggs on board his schooner which were hatched during the night, and in the morning the little birds flew readily across the cabin. Considering the great distances the hens come to deposit the eggs in a proper situation (often ten or fifteen miles), it seems extraordinary that they should take no further care of them. It is, however, quite certain that they neither do nor can watch them. The eggs being deposited by a number of hens in succession in the same hole would render it impossible for each to distinguish its own, and the food necessary for such large birds, consisting entirely of fallen fruits, can only be obtained by roaming over an extensive district; so that if the numbers which come down to this single beach in the breeding season, amounting to many hundreds, were obliged to remain in the vicinity, many would perish of hunger." Dr. Meyer says that the native name of this bird in Celebes is not Maleo, but Moleo.

Of a true *Megapodius* we have a good example in Cuming's Megapode (*Megapodius cumingi*), from North-western Borneo, and the following history of the species is given by Mr. Motley in his "Natural History of Labuan." He writes:—

"In Labuan they are not uncommon, and are said to be principally confined to small islands, to such, more especially, as have sandy beaches. They are very rarely to be seen, being extremely shy, and frequenting dense and flat parts of the jungle, where the ratans grow, and where the luxuriance of the vegetation renders concealment easy. The Malays snare them by forming long, thick fences in unfrequented parts of the jungle, in which, at certain intervals, they leave openings where they place traps. The birds run through the jungle in search of food, and coming to this fence, run along it till they find one of the openings, through which they push their way, and are caught in the trap. In walking they lift up their feet very high, and set up their backs something like Guinea Fowls; they frequently make a loud noise like the screech of a chicken when caught; they are very pugnacious, and fight with great fury by jumping upon one another's backs, and scratching with their long, strong claws. Their food principally consists of seeds and insects. The eggs are of a fine dark cream colour, and of a very large size, three of them weighing nearly as much as a full-grown bird. Accord-

BRUSH-TURKEYS AT WORK.

ing to the account given by the Malays, each bird lays about eight or ten eggs at each time of breeding, and their nests are merely large heaps of shells and rubbish deposited over the sandy soil in which the eggs are buried to the depth of about eighteen inches. Since receiving this account, however, we have had an opportunity of inspecting a very large and perfect nest, or breeding-hill, and found it to be about twenty feet in diameter, and composed of sand, earth, and sticks; it was close to the beach, just within the jungle, and scarcely above high-water mark, and appeared to have been used for many years. The boatmen seemed to have no clue to what part of the hillock contained eggs, but said they were never without some when frequented at all. They sought for nearly a half an hour in vain before they found one, and then they got about a dozen together; they were buried at a depth of from one to three feet, in an upright position, and the ground about them was astonishingly hard. The eggs thus deposited are left to be hatched by the heat of the sun, and this, the Malays assert, requires between three and four months to complete. Those obtained from this heap were brought home and buried in a box of sand, and a month or two afterwards it was discovered that they had all hatched, but that from neglecting to place them in a proper (*i.e.*, probably an upright) position, the chicks could not get up through the sand, and had all perished. When hatched, the chicks are almost entirely fledged; even the long quills being, as the Malay says, 'needled.' When first dug out, some of the eggs had lost much of their outer colour, which appeared to have scaled off, leaving only a white chalky shell. On a former occasion some eggs were brought by the natives, and were buried in a box of sand, and exposed to the weather: at the end of about three weeks one of the chicks was hatched. A Malay, who saw it emerge, said that it just shook off the sand and ran away so fast that it was with difficulty caught; it then appeared to be nearly half-grown, and from the first fed itself without hesitation, scratching and turning up the sand like an old bird. Two more afterwards emerged in the same state. Their eggs are held in such high estimation as food, both by natives and Europeans, that one cannot but fear that these interesting birds, though now so abundant, will ere long become scarce."

The late Mr. Gilbert Gould also describes the habits of the Mound-raising Megapode of Australia in a minute and exhaustive manner. The particulars which he furnishes about the mounds are very interesting:—

"I revisited Knocker's Bay on the 10th of February, and having with some difficulty penetrated into a dense thicket of cane-like creeping plants, I suddenly found myself beside a mound of gigantic proportions. It was fifteen feet in height and sixty in circumference at the base, the upper part being about a third less, and was entirely composed of the richest description of light vegetable mould; on the top were very recent marks of birds' feet. The native and myself immediately set to work, and after an hour's extreme labour, rendered the more fatiguing from the excessive heat, and the tormenting attacks of myriads of mosquitoes and sand-flies, I succeeded in obtaining an egg from a depth of about five feet. It was in a perpendicular position with the earth surrounding and very lightly touching it on all sides, and without any other material to impart warmth, which, in fact, did not appear necessary, the mound being quite warm to the hands. The holes in this mound commenced at the outer edge of the summit, and ran down obliquely towards the centre; their direction was therefore uniform. Like the majority of the mounds I have seen, this was so enveloped in thickly foliaged trees as to preclude the possibility of the sun's rays reaching any part of it.

"The mounds differ very much in their composition, form, and situation; most of those that are placed near the water's edge were formed of sand and shells, without a vestige of any other material, but in some of them I met with a portion of soil and decaying wood. When constructed of this loose material they are very irregular in outline, and often resemble a bank thrown up by a constant surf. One remarkable specimen of this description, situated on the southern bank of Knocker's Bay, has the appearance of a bank from twenty-five to thirty feet in length, with an average height of five feet; another, even more singular, is situated at the head of the harbour, and is composed entirely of pebbly iron-stone, resembling a confused heap of sifted gravel; into this I dug to the depth of two or three feet without finding any change of character. It may have been conical originally, but is now without any regularity, and is very extensive, covering a space of at least a hundred and fifty feet in circumference. These remarkable specimens would, however, seem to be exceptions, as by far the greater number are entirely formed of light, black, vegetable soil, are of a conical form, and are situated in the densest thickets. Occasionally the mounds are met with in barren, rocky, and sandy situations, where not a

particle of soil similar to that of which they are composed occurs for miles round; how the soil is produced in such situations appears unaccountable. It has been said that the parent birds bring it from a great distance; but as, as we have seen, they readily adapt themselves to the difference of situation, this is scarcely probable. I conceive that they collect the dead leaves, and other vegetable matter that may be at hand, and which, decomposing, forms this particular description of soil. The mounds are doubtless the work of many years, and of many birds in succession; some of them are evidently very ancient, trees being often seen growing from their sides. In one instance I found a tree growing from the middle of a mound which was a foot in diameter. I endeavoured to glean from the natives how the young effect their escape; but on this point they do not agree, some asserting that they find their way unaided, others, on the contrary, affirmed that the old birds, knowing when the young are ready to emerge from their confinement, scratch down and release them.

"The natives say that only a single pair of birds are ever found at one mound at a time, and such, judging from my own observation, I believe to be the case. They also affirm that the eggs are deposited at night, at intervals of several days, and this I also believe to be correct, as four eggs, taken on the same day, and from the same mound, contained young in different stages of development; and the fact that they are always placed perpendicularly is established by the concurring testimony of all the different tribes of natives I have questioned on the subject.

"The Megapode is confined almost exclusively to the dense thickets immediately adjacent to the sea-beach; it appears never to go far inland except along the banks of creeks. It is always met with in pairs, or quite solitary, and feeds on the ground, its food consisting of roots, which its powerful claws, enable it to scratch up with the utmost facility, and also of seeds, berries, and insects, particularly the larger species of coleoptera. It is at all times a very difficult bird to procure; for although the rustling noise produced by its stiff pinions when flying may be frequently heard, the bird itself is seldom to be seen. Its flight is heavy and unsustained in the extreme. When first disturbed, it invariably flies to a tree, and on alighting stretches out its head and neck in a straight line with its body, remaining in this position as stationary and motionless as the branch upon which it is perched; if, however, it becomes fairly alarmed, it takes a horizontal but laborious flight for about a hundred yards, with its legs hanging down as if broken. I did not myself detect any note or cry, but from the natives' description and imitation of it, it much resembles the clucking of the domestic fowl, ending with a scream like a Peacock.

"I observed that the birds continued to lay from the latter part of August to March, when I left that part of the country; and, according to the testimony of the natives, there is only an interval of about four or five months, the driest and hottest part of the year, between their seasons of incubation. The composition of the mound appears to influence the colouring of a thin epidermis with which the eggs are covered, and which readily chips off, showing the true shell to be white. Those deposited in the black soil are always of a dark reddish-brown, while those from the sandy hillocks near the beach are of a dirty yellowish-white; they differ a good deal in size, but in form they all assimilate, both ends being equal. They are three inches and five lines long, by two inches and three lines broad." *

As to the very curious method of incubation adopted in the case of these Mound-birds, or Megapodidæ, the common supposition has been that these birds, with their large feet and long curved claws, raked together earth, dead leaves, rotten sticks, stones, and so on, till perhaps they formed a mound as much as six feet high and twelve feet long. This they frequently did in company, and the "incubator" thus formed was shared by a number, who laid their eggs in it, and left them to be hatched by the heat evolved by the decaying substances. Compare, however, with the above account the latest observations on the subject, namely, those of Mr. H. N. Moseley, F.R.S. He says, in his "Naturalist on the *Challenger*," that "the eggs [of Megapodius] were buried in the clean sand, at a depth of three-and-a-half or four feet, and with no mound over them, or vegetable rubbish of any kind. The eggs are thus hatched by the simple warmth of the sand received from the sun, and retained during the night, just in the same manner as turtle's eggs are hatched. . . . . I had always supposed that these birds and their allies hatched their eggs by means of the heat derived from decayed vegetable matter."

* Gould's "Handbook to the Birds of Australia," Vol. II., p. 171.

CHAPTER VIII.

THE WADING BIRDS.

Chief Characters of a Wading Bird—General Habits—THE RAILS—Distinctive Features—THE JACANAS—Foot—Distribution—The Pheasant-tailed Jacana—THE TRUE RAILS AND CRAKES—Characteristics—The Water Rail—The Corn-crake, or Land Rail—THE WATER HENS—The Blue Water Hens—The Common Water Hen, or Moor Hen—Its Habits—Its Nest—Its Young—Its Bad Character—THE COOTS—Foot Characters—Appearance—Nest and Eggs—THE FINFOOTS—THE SNIPES—Distinctive Features—THE CURLEWS—Their Curved Bill—The Red-billed Curlew—The Painted Snipes—Anomaly about the Females—The Curlews—THE SANDPIPERS—The Collector's Quest—Summer Snipes—Terns—Godwits—Plover Acting as Sentinel—The Dunlin—The Curlew Sandpiper—The Knot—The Ruff—THE PHALAROPES—THE STILTS, OR STILT PLOVERS—The Avocet—The Stilts—THE PLOVERS—THE TURNSTONES—THE TRUE PLOVERS—The Lapwing, or "Pee-wit"—Mr. Seebohm's Account of the Habits of the Grey Plover—Golden Plovers—Sand Plovers—THE OYSTER-CATCHERS—THE BUSTARDS—Characters—The Thick-knee, or Stone Curlew—The Coursers—Dr. Brehm's Account of the Habits of the Great Bustard—THE CRANES—The Kagu—The Sun Bittern—THE COMMON CRANE—Stories of Von Seyffertitz's Tame Crane—THE TRUMPETERS.

THE SIXTH ORDER OF BIRDS.—THE WADING BIRDS (GRALLÆ).

THE principal character of a Wading-bird is the long leg, with the bend of the tarsal joint unfeathered, and the toes long and cleft nearly to the base. The head is small, and the bill in most of them long and narrow, the body compressed, the wing long, excepting in the case of the Rails. They can nearly all swim well, but as a rule do not do so, searching for their food by the reedy banks of rivers or on the sea-shore, and most of them are of shy or skulking habits. They are principally migratory birds, and include among their number some of the farthest ranging species in the world. Most of the Waders breed in northern latitudes, many only within the Arctic Circle, and at the end of the nesting season they migrate, either singly or in flocks, down to the extreme south, in America, Africa, and even to Australia and New Zealand.

In the birds which are here enumerated as *Gralle* the nasal openings are large, placed low in the upper mandible, and are either surrounded or shut in by a rather broad soft skin. The bill varies greatly, but as a rule is narrow and compressed. None of the *Gralle* are of very large size; and with the exception of the Rails, which generally construct a nest, the eggs are mostly placed on the bare ground. The young of all are able to shift for themselves almost the instant they are hatched.

THE FIRST FAMILY OF THE GRALLÆ, OR WADING BIRDS.—THE RAILS (*Rallidæ*).

Amongst the many long-winged species which form the majority of Wading-birds, the Rails stand out very conspicuously for their short wings, which are concave as well, and fit the body closely. This is a provision of nature wonderfully well adapted for the habits of the Rails, whose bodies are extremely thin and slender, enabling them to thread their way through the reeds in search of their food with the greatest ease. The skulking habits of most of them give an idea of their being bad flyers, but this is by no means the case, for most of them are migrants, and some of them take long voyages; the Corn-crake, for instance, nesting in Europe, and betaking itself to South Africa during the British winter; the Moor-hen and many of the European Crakes (*Ortygometra*) making the same long journey, though they are not so completely migratory from England as the Corn-crake.

A Rail has rather a long hind toe, the forehead much flattened, and the fore part of the crown depressed, but it is principally by their compactly plumaged and thin body, and the long spider-like toes, that they are generally recognised. They feed on small insects, worms, seeds, and fragments of plants, while such larger sized birds as the Moor-hen or Coot will eat eggs, and even kill chickens and carry them off.

The Rallidæ may be subdivided into five sections, which may be considered as sub-families.

THE FIRST SUB-FAMILY OF THE RALLIDÆ.—THE JACANAS (*Parrinæ*).

The form of the foot separates the five sub-families of the Rails, and the Jacanas are easily recognisable by the extremely long and straight claws, which render them totally unlike any other birds in this respect. They are inhabitants of warm climates only, being found in South America, Africa, India, and Australia. Many of them have a shield on the forehead, like the Coots and

Moor-hens, but they are more variegated in colour than either these birds or the rest of the Rails. The young birds, however, are not so handsomely coloured as the adults.

THE PHEASANT-TAILED JACANA (*Hydrophasianus chirurgus*).

This is the largest of all the Jacanas, and is a native of India and Ceylon, where it inhabits jheels, marshes, and reedy banks, but it is rather bolder in its habits than the other Indian species. Dr. Jerdon says that the breeding plumage is assumed very early, as he has seen some specimens with their summer dress and long tail in February, so that it is probable that some birds do not always put on a winter dress; as a rule, however, they do not change till May or June. According to the same observer, it makes a large floating nest of dried pieces of grass and herbage, sometimes, according to other accounts, of the stalks of growing rice, which it bends downwards and intertwines, and it lays in July and August from four to seven eggs, occasionally more, of a fine bronze brown or green. It has a loud call, likened by some to the mewing of a cat or a kitten in distress, by others to the distant cry of a hound; an imitation of the sound is attempted in the Hindustani names Piho and Meewah. The Cingalese also, according to Layard, call it *Cat-Teal*. Like the other Indian species, it feeds chiefly on vegetable matter, but also on shells and water insects. In Purneah the natives say that before the inundation, *i.e.*, before the breeding season, it calls *Dub, dub*—"Go under water;" and afterwards in the cold weather, *Powar*, which, in Purneah dialect, means "next year." In winter this species is gregarious. If only wounded it is difficult to find, as, like the English Moor-hen, it dives at once and remains with its bill only out of the water. The flesh is said to be excellent. Blyth states

JACANA.

that he has kept both the Indian Jacanas in confinement, and that they thrive well on shrimps, but the present bird was in the aviary rather quarrelsome with its kind.

THE SECOND SUB-FAMILY OF THE RALLIDÆ.—THE TRUE RAILS AND CRAKES (*Rallinæ*).

In this sub-family the claws are short, there is no frontal shield on the head, and the toes, though long, are simple and without any lobes. Many of them are of large size, such as the great *Aramus* of South America, or the Wood-hens (*Ocydromus*) of New Zealand. The latter cannot fly, though they are of the size of a barn-door fowl.

The most typical members of this sub-family are undoubtedly the Water Rails (*Rallus*) and the

CORN-CRAKE, OR LAND-RAIL.

Crakes (*Ortygometra*), both of which are represented in England, the former by one, the latter by several species. The Water Rail (*Rallus aquaticus*) may be easily told by its brown coloration and banded flanks, but particularly by its long bill, which exceeds the head in length, whereas in the Crakes this is not the case. The upper mandible and the tips of the lower one are blackish-brown, the rest of the latter reddish. In colour the bird is brown, streaked with black, less distinctly on the head; the quills and tail blackish-brown; lores and eyebrow, sides of face, and under parts slaty-grey; the abdomen and under tail-coverts ochre-colour; flanks black, banded across with white; the iris is red. The male measures about eleven inches in length; the female is smaller. The attenuation of the body may be gathered from the fact that, although nearly a foot in length, it is not three inches across the back, and hence the facility with which it threads its way through the reeds, scarcely ever rising, unless driven to do so by a dog; so that, although resident in England all the year round, it is seldom seen. It is by means of keeping close in the marshes and bogs, which it affects, that it gains its best assurance of security, as it is by no means a good flyer, though it swims and dives with agility.

Its nest is placed on the ground, in close herbage or amongst reeds, and the number of eggs varies from six to ten. As with many of the Rallidæ, the chicks are nothing more than little balls of fluffy black down when first hatched, but on the least alarm they take to the water, and conceal themselves with much adroitness in the adjoining rushes or grass.

The Corn-crake, or Land Rail (*Ortygometra crex*), is a summer visitor to England, and speedily makes known its arrival by its call, which may be heard resounding throughout the night, and even in the daytime. Its cry is very harsh, and may be imitated by rubbing a bit of wood sharply along the teeth of a comb; it is uttered by the male bird only, and is heard more on its first arrival, ceasing almost entirely when the young are hatched, as is the case with so many other birds. As a rule, the haunts of this species are confined to fields of long grass or corn, and oftentimes the nest is mowed out when the hay is cut, the scythe not unfrequently decapitating the faithful mother, who sits very close, and has been known even to carry away her nestlings out of reach of danger. It does not, like its cousin the Water Rail, frequent marshes or wet ground, though it is often found in hay-fields close to rivers, and it can swim with vigour when forced to do so. A companion was walking one evening with the writer by the banks of the Thames when the cry of a Land Rail was heard at a short distance off, and after some trouble was driven to take wing, when a well-directed throw of a walking-stick brought it to the ground, within a few feet of the river-bank. It lay apparently dead, but on being approached it suddenly sprang up, and without any hesitation plunged over a steep bank into the river, and notwithstanding a broken wing, it managed to cross at a place where the river was not less than seventy yards broad. The bill in the Land Rail is much stouter than in the Water Rail, not exceeding the head in length, and the general colour is more of a reddish-brown. In the autumn the old birds depart with their families, migrating in silence and concealment for their winter home, which is the continent of Africa, where the species passes down the Nile Valley as far as the Cape Colony. In September the Land Rail is often met with in the clover and turnip-fields, and we have known as many as eight to be killed in a single day when out Partridge-shooting. The flesh is very good for the table. The young are covered with black down when first hatched, and moult before migrating.

The other members of the sub-family Rallinæ are very numerous, and are distributed over the entire globe.

THE THIRD SUB-FAMILY OF THE RALLIDÆ.—THE WATER-HENS (*Gallinulinæ*).

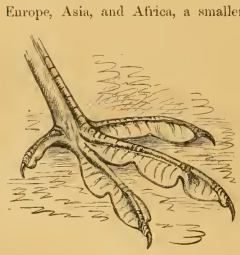
In this sub-family occur the brightest plumaged of the Rails, viz., the Blue Water-hens (*Porphyrio*), the members of this genus being found everywhere, excepting the northern parts of the Old and New Worlds. They very much resemble the English Water-hen, or Moor-hen, in their habits, but are much larger and more stately-looking birds, while in flight their beautiful blue plumage shows to advantage; they also have a very large red frontal shield.

THE COMMON WATER-HEN, OR MOOR-HEN (*Gallinula chloropus*).

Passing a large pond or sheet of water in a railway-carriage, the observer may often see a small black bird swimming near the edge of the reeds, or flying out of danger with a flapping of the wings that leaves a long trail of disturbed water behind it to mark its flight. This will be either a Moor-hen or a Coot; but even at some distance the two species can be easily recognised, the ivory white shield on the forehead of the latter being always very conspicuous. The frontal shield of a Water-hen is red, and from being much smaller is not so easily seen. With the exceptional case of Mr. Waterton, who managed by protection to make wild birds tame, the Coot is much more shy in its nature than the Moor-hen, and does not so often become fearless and confiding like the latter bird. When unmolested the Moor-hen will often quit his native pond or lake and be allured to the lawn or neighbourhood of the house, coming regularly for its food. The writer, indeed, remembers having visited a gardener's cottage, in Leicestershire, where a pair of Moor-hens came from a neighbouring pond at the call of the old woman who lived in the little house, and not only fed themselves within a few yards of the spectators, but even brought their young brood to share the repast afforded by their kind protector. Skirting the lake in a boat, one is first made aware of the presence of a Moor-hen by the warning croak which is heard from the reeds some distance ahead, for the bird is fully conscious of danger, and long ere the boat approaches may be seen swimming rapidly to the shore from the middle of the lake

towards the friendly reeds which skirt its edge. Here it will be difficult to flush the birds without the aid of a dog, but carefully proceeding along the margin of the rushes, the naturalist will probably be gratified by the "sough" of a body falling into the water, and will find, close by, the nest, raised a little above the water, and concealed from the bank by a mass of intervening reeds. Many yards off the bird will itself emerge and betake itself, with flapping wings, and legs hanging down, to the opposite side of the lake, although we have known the hen bird, if the eggs are hard-set or the young newly-hatched, to stay in the vicinity of the nest and croak as if in anger, or more probably in the latter case to encourage the young birds with her presence. The nest is large and rather flat, composed of dead rushes, and perfectly warm and dry, the chicks when hatched being merely tiny balls of black down with pretty little red heads. They utter a "cheeping" note, which may be often heard inside the egg, before the little one has broken through the shell. We have more than once watched the process of hatching, and seen the egg with a small hole chipped in it, through which the tiny bill, with a little ivory white nail at the tip, is trying to force its way out. It is possible that at this stage the old bird assists the chick to break the shell and extricate itself, as on one occasion, when we broke the egg very carefully, and deposited the young one in the nest, it died soon after. Should the old mother be sitting on the nest with her young ones, she drops gently off, and all the little ones scramble out helter-skelter, and so carefully do they conceal themselves, that it is almost hopeless to find them. The nest is often situated in more exposed positions than the one above described, and may be found placed on the water-line in the branches of some overhanging shrub or tree whose boughs touch the water, but always at some distance from the bank, so that a boat is generally necessary to procure the eggs. The latter are from seven to ten or eleven in number, two broods being generally reared in a season, and the number of eggs is less in the second than in the first brood. When swimming the Moor-hen jerks its head as if to keep time with the motion of its legs, which are generally somewhat out of the water, so as to show the tarsal joints, which are red and yellow, shading off into green; and these colours, and its red frontal shield, are the only ornaments about the bird, if we except the two white patches on each side of the tail. The latter is usually carried somewhat erect and with a jerking motion, the bird, as it walks or swims, flicking the latter organ in unison with the movements of its head and legs. When frightened, Moor-hens, especially young birds, often take refuge in trees, and run with considerable rapidity along the branches. The bird is, as a rule, tabooed by keepers, who assert that they are not above visiting pheasantries and carrying off young chickens, whom they despatch with a blow of their powerful bill on the head of their victim; nor can they refrain from stealing eggs when these are left unprotected, sharing in this respect the odium which attaches to their relations, the Coots.

The Moor-hens are found nearly all over the world, and the British species is distributed over Europe, Asia, and Africa, a smaller kind taking its place in the Malayan Islands and extending to Australia. In America Moor-hens are found almost everywhere, while in the Samoan Islands a curious species exists, the *Pareudiastes pacificus*, which is said not to be able to fly.



FOOT OF COOT.

THE FOURTH SUB-FAMILY OF THE RALLIDÆ. THE COOTS (*Fulicinæ*).

In appearance and habits much resembling Moor-hens, the Coots are nevertheless a distinct sub-family, distinguished by their lobed toes, which are best understood from a glance at the accompanying woodcut. They have also a larger frontal shield, which in certain of the American species may be really called enormous. Coots are found everywhere, but the South American region possesses the larger number of species, no less than seven being met with in the Neotropical area. Like the Moor-hens the Coots affect the water, but seem to prefer more exclusively large ponds and lakes, and are not to be found by the river side, where the Moor-hen can always be seen. The Coot also assembles in greater numbers than the Moor-hen, large flocks being often seen in the winter on some of the tidal harbours of the south coast of England.

The Coots are all birds of moderate size, some attaining the dimensions of a small Goose, but the English species does not exceed those of a good-sized fowl. The plumage is extremely close, compact, and impervious to wet, and the body appears rather clumsy to the observer, but in the water the bird's movements are by no means ungraceful, as it swims with the same ducking motion as the Moor-hen already described. The nest is built of dead rushes, often ornamented with the stalks and

COOT.

flowers of the marsh-marigold intertwined with the reeds. It is rather a large structure, and somewhat flat, but, though floating on the water, it is always perfectly dry inside. It is built in rather more exposed situations than the Moor-hen's among the branches of a dead bough jutting out of the water, or even among the reeds on the shallow side of a lake. The eggs are about eight in number, as a rule, and are of a light brown colour or yellowish-grey, covered with small dots of brownish-black. The young, when first they emerge from the egg, are prettier than at any other time of their life, being covered with black fluffy down, but having the head red, with a shade of bluish-purple.

THE FIFTH SUB-FAMILY OF THE RALLIDÆ.—THE FINFOOTS (*Heliornithinæ*).

These curious birds have the feet lobed as in the Coots, but differ in having a long bill and compressed head, not unlike that of a Heron, and also at the same time somewhat resembling that of a Grebe. Two genera are contained in this sub-family, the first (*Heliornis*), having but a single species, generally known as the American Finfoot (*Heliornis fulica*), from the tropical portions of Central and South America. Prince Maximilian of Neuwied states that it is by no means rare on the rivers of Eastern Brazil, but from its habit of concealing itself in the herbage it is not often observed. It may frequently be noticed sitting on a thin branch, partially immersed in the water, and occupied in bowing its head in a most curious manner. The plumage is peculiarly soft. The bird is said to possess the powers of diving in an inferior degree to most of the Rails. In Africa the *Heliornis* is replaced by the genus *Podica*, of which there are three species, two peculiar to the Ethiopian region, while the third, the Masked Finfoot (*Podica personata*), is a native of the Burmese countries and Malacca.

THE SECOND FAMILY OF THE GRALLÆ, OR WADING BIRDS.—THE SNIPES (*Scolopacidæ*).

No portion of the globe seems to be without some representative of this family, some of the members of which are migratory and extend over a wide range, whilst others are comparatively local, the Auckland Islands, for instance, possessing a species of Snipe peculiar to themselves. In the Scolopacidæ the bill is long and very slender, as well as weak, so that instead of being firm and horny, as in most Wading-birds, it is flexible and bends under pressure. The wings are long and pointed, and the secondaries are extremely long, nearly equalling the primaries in length. They frequent bogs and marshes or the banks of rivers and ditches, where they are enabled to get their food, which consists of worms, insects, and testaceous mollusca, these being obtained by probing the soft ground. They are, as regards the English species at least, almost without exception migrants, visiting the shores of Great Britain in April or May, and departing in August and September, when they assemble in flocks on the sea-coasts, sometimes in considerable numbers. A few species, however, such as the Woodcock and the Snipe, are more generally distributed in England in the winter.

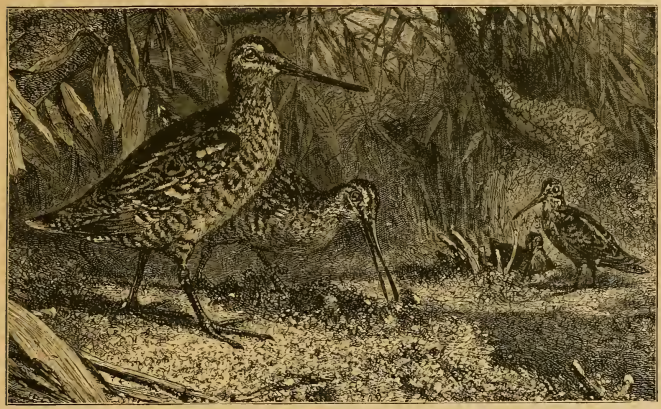
WING OF SNIPE. (A, Secondaries; B, Primaries.)

THE FIRST SUB-FAMILY OF THE SNIPES.—THE CURLEWS (*Numeniinæ*).

These are the largest birds of the family, the Common Curlew, a well-known English bird, being nearly of the same bulk as a chicken, though appearing much larger, from its long legs and enormous curved bill. The bill is always arched, and the nasal groove in which the nostrils are placed reaches to its tip.

The first genus (*Ibidorhynchus*) contains but one species, the Red-billed Curlew (*Ibidorhynchus struthersii*), which is found only in the Himalaya Mountains and the hills of Central Asia. It is said to inhabit in the former range the large rivers which rise from the snow and have a broad, sandy channel. It is nowhere common, and is generally seen singly, though occasionally met with in small parties of five or six. It has no hind toe, and the nasal groove is rather shorter than in the Painted Snipes and Curlews. The second genus contains the Painted Snipes, as they are called (*Rhynchæa*), a genus which is somewhat remarkable from the great difference which is observable in the coloration of the sexes. As a rule, the only distinction between the males and females in the Snipes is one of size, but in the Painted Snipes the females are more richly coloured than the males, having the lores, sides of face, and neck chestnut. This genus is quite an anomaly in the class Aves, where the females are almost always duller-coloured than the males, or at least merely resemble them in plumage, though in some of the Hemipodes (*Turnix*) the colours of the hen bird are brighter than in the males, and in the Hawks the female is generally the larger and more powerful bird. The Painted Snipes are found in Africa, India, and Australia, while one species is met with in the southern countries of the South American continent.

The Curlews (*Numenius*) are found in every part of the world, arriving in the northern regions in summer, and passing south in considerable numbers in the autumn. The note of these birds has something plaintive and wild in its composition, whether it be heard on the moorland, where the species nests, or on the dreary mud-flats of a tidal river or harbour. In the autumn the latter places are visited by numbers of Curlew on their way to their winter quarters, and in many parts they are called by the gunners and fishermen tame Curlews, as they are so much more easily obtained at this season, the reason being that the flocks are then principally composed of young birds of the year taking their first migratory journey south. The old Curlew is a much more wary bird, especially on the return journey in April and May, when he travels, either singly or in company with his mate, to



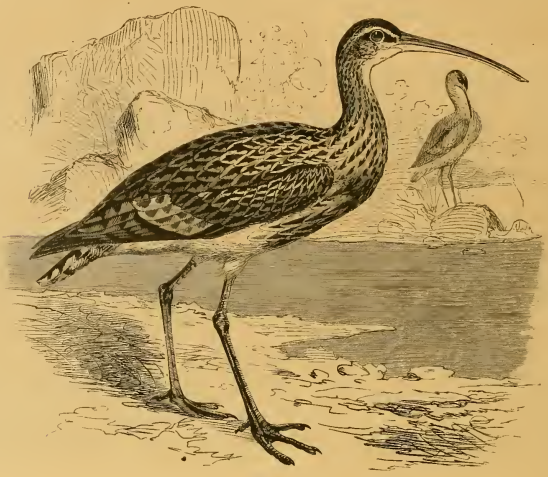
COMMON SNIPE.

the upland moors in Scotland and the northern counties of England, where he is to rear his young. In size the Curlew is about two feet and a quarter in length, and has a curved bill of from six to eight inches, and even these latter dimensions are sometimes exceeded.

THE SECOND SUB-FAMILY OF THE SNIPES.—THE SANDPIPERS (*Totaninæ*).

In these birds the bill is straight or slightly curved up, the toes at the base joined by a fold of skin. All the Godwits and Sandpipers make up this sub-family, many representatives of them being met with at the autumn migration on the English coasts. Leaving the little inn, where the collector on a shooting excursion has to put up, he will betake himself to his hunting-ground, which is probably some tidal harbour or mouth of a tidal river. A boat with an apt oarsman, a gun with plenty of cartridges, and a certain stock of food to last for himself and the fisherman during the day's outing, constitute all the outfit which a keen collector will require for his expedition after the Sandpipers. The tide will now be coming in, and the channel in the middle of the harbour, no longer sunk between two deep banks of black mud, will be momentarily broadening under the influx of the approaching tide, so that its course can now be distinctly traced to the mouth of the harbour two miles away. As the sportsman seats himself in the narrow little boat or punt, and his bare-legged pilot pushes her off, takes his seat in the stern, and works her head along by means of his single oar or paddle, the continued cries of the shore-birds resounding far away on every side will tell the listener that they, too,

await the advent of the sea, which will gradually spread itself over the waste of black mud which they have been probing for their food during the livelong night, and drive them foot by foot to the shelter under the banks of the harbour or out on the sea-beach. A small bird flies off with a thin piping whistle from the muddy bank of the main channel, and hugs the margin of the latter till it disappears round the nearest bend. This is the Common Sandpiper, or Summer Snipe (*Tringoides hypoleucus*), returning from his breeding quarters farther north, and now on his way to his winter home in far



CURLEW.

South Africa. It is not only on the sea-shore that we may meet with this elegant little species, for in the spring it may be seen along the banks of our rivers and lakes in company with its mate; while in the autumn the old birds with their family are again observed on the river banks or on its sandy sides, now returning to the sea-coast, where they no longer keep so well together, but are found in scattered parties of two or three, generally very shy and wary.

Those fairy-like birds on ahead, flitting at a little distance above the waves, and every now and then dipping into the water with a splash, are little Terns (*Sternula minuta*), but the eye of the ornithologist is more forcibly attracted by three or four dark objects which stand out against the margin of the sand-bank some three hundred yards ahead. Godwits they are; and already the long, straight beak can be distinguished as the birds sit with their head resting on their buff-coloured breasts. They are evidently uneasy at the approach of the skiff, and evince their fear by taking short runs a little in advance. At length they stop, glance for a moment, and take flight for the shingly beach in the distance, but too late to escape a well-directed double-barrel, which brings down three of their number. Placing them under the side of the boat, the sportsman satisfies himself, by a glance at the banded tail, that they are the Bar-tailed Godwit (*Limosa lapponica*), and not the rarer Black-tailed Godwit (*L. ægocephalus*), which also comes to England. The boat is now steered for a shingly island which is evidently not about to be covered by high water, and here, ensconced behind a large heap of seaweed which commands a spit of sand and shingle jutting out into the harbour, the two gunners

await the arrival of the high tide which will soon bring the last vestige of mud-flat under water. They have arrived in the nick of time, for at first singly, and then in small flocks, the Waders make for the sea-shore, in nearly every case crossing the sandy spit on their way, allured in many instances by the subtle imitation of their cries which the fisherman knows how to emit, and thus they leave a considerable number of their comrades in the hands of the gunners. With a musical modulated note of three syllables a little bird comes skimming along far out over the water, and appearing all white as he approaches. He scents danger, however, before he comes too close, and flies away without receiving a shot. This is the Ringed Plover (*Ægialitis hiaticula*), and so wideawake a bird that there is small

RUFFS FIGHTING.

chance of getting near a flock of Sandpipers if one of these little Plovers is acting sentinel. Perched on the highest ridge of the shore, he runs provokingly along, keeping a safe distance ahead, and whistling continually, till at last he takes wing, and the sportsman is just in time to see the hurried flight of the flock of Dunlins and Sandpipers, over whom the bird has been keeping guard, far out at sea, with the sentinel Plover in advance guiding them to a safer spot farther down the beach. The Dunlin (*Tringa alpina*) is not often found on the rivers inland, but is an extremely common shore-bird, being generally met with in large flocks, sometimes as many as two or three hundred in number. They are usually very tame, and are easily attracted by whistling, so that a flock, though fired into two or three times, will yet wheel round again and again on hearing the deceptive whistling of the gunner. They go to the north, as a rule, to breed, but during the nesting season flocks may be found on the southern shore of England, which, although in full summer plumage, evidently do not breed, but remain in flocks throughout the whole season. The summer dress of the Dunlin is easily recognisable by the large black horseshoe mark on the

breast. This is lost in winter, when the plumage is ashy above and white below. At the time of the migration of the other Waders the Dunlins are generally putting on their winter plumage, and are met with in all stages of transition.

The Dunlins are not the only visitors to the sandy island where our two sportsmen are waiting for the fall of the tide. A single bird settles and is secured, and proves to be a Curlew Sandpiper (*Tringa subarquata*), a species not unlike a Dunlin in winter dress, but always to be distinguished by its longer and more curved bill, which, from its supposed resemblance to that of the Curlew, has gained for the bird its trivial name. In summer, however, it is very easily told by its deep red breast, for, like the Knot or the Godwits, the whole under surface becomes deep chestnut during the breeding season. Conjectures as to the breeding-home of this species, so widely spread and not uncommon during its two migrations, cross the mind of the shooter who has procured a specimen, for as yet we are ignorant of the place where the Curlew Sandpiper breeds. No longer can this be said of the Knot (*Tringa canutus*), whose nesting-place was unearthed by the last English expedition to the North Pole; and in the British Museum may be seen a pair with their nestlings, procured by Captain Feilden, of the *Alert;* no authentic eggs, however, as yet exist in any collection. The Knot visits England in large numbers in autumn, and wanders on its winter migration as far as the Cape, and even to Australia, returning to breed far within the Arctic Circle. In summer the plumage is very rich, the breast being deep chestnut; whereas in winter, like so many other Waders, the back becomes ashy-grey, and the breast white.

One of the most remarkable of all the Sandpipers is the Ruff (*Machetes pugnax*). The males, in the breeding-season, have a conspicuous tuft of feathers on each side of the head, and a large breast-shield of plumes; and the curious part of the bird's economy is that in no two specimens are these absolutely alike. Sometimes the frill and breast-plumes are black, sometimes pure white; occasionally they are rufous barred with black, or grey with white bands; in fact, the combinations of colours are too numerous to be detailed. In winter the Ruff loses this frill and becomes much plainer in colour, resembling the female in plumage, but always maintaining a larger size, so that even in winter dress the sexes can be distinguished. The specific name of *pugnax* is bestowed upon this bird on account of its fighting propensities, the most furious battles taking place between the males for the possession of the females, and in these combats the feathered frills act as a shield for the protection of the combatants. Large numbers of Ruffs are sent annually to the markets of England, principally from Holland, where the species still breeds, as it does also over the greater part of Northern Europe. The drainage of the fens, however, has driven it from England, where it now only occurs in migration. Its winter home is Africa. The habits of a few of the commoner English Wading-birds which have been treated of above may be taken as examples of the group at the season of the year when they are most generally observed.

THE THIRD SUB-FAMILY OF THE SNIPES.—THE PHALAROPES (*Phalaropinæ*).

The Phalaropes are distinguished by their lobed toes, which look like those of a miniature Coot. They combine the characters of several of the Wading-birds, as they swim well by means of their lobes on the toes, which are also united by a web at the base, while they can run on the shores like a Sandpiper. The species are only three in number, and all are inhabitants of northern climates. Two are found in Great Britain, and extend throughout Northern Europe and Northern Asia, while one species, Wilson's Phalarope, inhabits North America.

The Red-necked Phalarope (*Phalaropus hyperboreus*) is a handsome little bird, having the upper parts blackish-grey, varied with reddish edgings to the feathers, the sides of the neck and fore-neck being chestnut, the throat, breast, and abdomen white. Like the Sandpipers, which it much resembles in its appearance, it has a winter plumage, which may be described as blackish-grey, with the forehead, cheeks, and under parts white. The wings have a white band. The Red-necked Phalarope breeds in the Orkney and Shetland Isles, where it constructs its nest in the grass near the edges of lakes, and lays four eggs. Its food consists of insects, worms, and mollusca. It swims with ease, and is often seen far out at sea, migrating southward in winter, when both it and the Grey Phalarope (*Phalaropus fulicarius*), which is the other English species, wander as far as the Indian Ocean, and even to the Moluccas. Dr. Jerdon calls these birds "Coot-footed Stints," which gives a very good idea of the nature of a Phalarope.

THE FOURTH SUB-FAMILY OF THE SNIPES.—THE STILTS, OR STILT PLOVERS (*Himantopinæ*).

These birds are remarkable for their extreme length of leg, which exceeds the whole extent of the body, and for their long slender bill. The Stilts and the Avocets (*Recurvirostra*) comprise the two genera which constitute the sub-family. In the last-named birds the bill is slender and up-turned. Both genera are world-wide in their distribution, occurring in all six regions of the globe, though they do not wander very far north. In England the Avocet is a very rare bird, though it is still plentiful in some parts of Holland, where it can find suitable breeding-places. As a rule, Avocets frequent the pools in marshes or by the margins of rivers, but some species occur high up in the mountains, as in the case of the Avocet of the Andes. The feet are webbed to such an extent that early writers placed them among the swimming birds, but as a matter of fact they never swim, unless forced to do so, though the webbed feet are admirably adapted for the progression of the bird over the slimy ooze and mud where it seeks its food.

AVOCET.

The Stilts have a straight bill, but in other respects they are not unlike the Avocets, and, like the latter, most of the species have a black and white plumage, though in New Zealand a jet-black Stilt occurs. They are more sociable in their ways than the Avocets, being sometimes found in large flocks, which separate into pairs at the time of the breeding season. At the latter season they frequent fresh or brackish water, but in the winter they are found in the vicinity of salt lakes. The Black-winged Stilt (*Himantopus himantopus*) has more than once occurred in England. It is a very slender bird, measuring about fourteen inches in length, and the plumage is black and white, the former changing in winter to an ashy blackish shade. The bill is black, the legs pink or carmine-red, and the eye is beautiful carmine.

THE THIRD FAMILY OF THE WADING BIRDS, OR GRALLÆ.
THE PLOVERS (*Charadriidæ*).

These Wading-birds are similar in habits and ways to many of the Sandpipers, but are much more stoutly built, and have, as a rule, not nearly such long bills. The latter rarely exceeds

the length of the head, and is stout as well as hard in character, with a broad nasal groove. The base of the bill is in many species soft, and forms a kind of cere, while the end of the bill is hard and swollen. The wings are pointed and the secondaries are long. The Plovers may be subdivided into three sub-families, the Turnstones, the Plovers, and the Oyster-catchers.

THE FIRST SUB-FAMILY OF THE PLOVERS.—THE TURNSTONES (*Strepsilatinæ*).

The Turnstones are found everywhere, the common species (*Strepsilas interpres*) being met with all over Europe, and visiting in winter Africa, and even Australia. In South America the Black-headed Turnstone (*S. melanocephala*) occurs, and the New World contains also two very curious birds belonging to this sub-family, each the sole representative of its genus *Aphrizа virgata* and *Pluvianellus sociabilis*. The former of these extends along the Pacific coast of South America, down the continent of South America as far as the Strait of Magellan, while the *Pluvianellus* is only known to inhabit the latter locality.

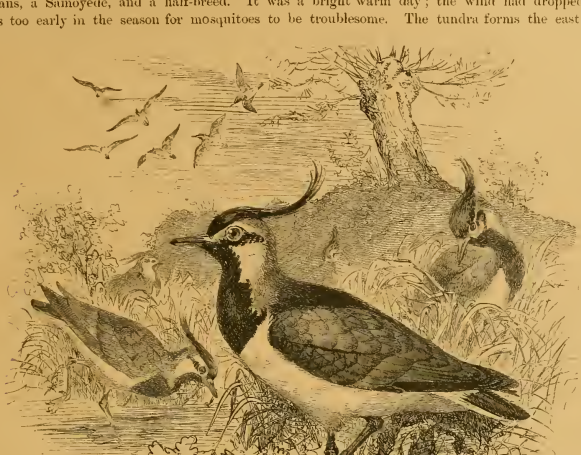
The Turnstone passes by Great Britain on its way to the north in the spring, but does not breed there. In Norway it nests, however, as well as in high northern latitudes, and the eggs were found near Discovery Bay, the winter quarters of H.M.S. *Discovery* during the recent Arctic Expedition. In the autumn, on the return journey, they are much more plentiful, and may be often seen in small bunches of four or five, sitting quietly on the muddy shore of a tidal river or inland harbour. These companies are for the most part composed of young birds, and are not very shy; occasionally single specimens may be met with on some shingly shore, where their colour serves to conceal them entirely, nor is it till the bird suddenly flies up that its presence is detected.

THE SECOND SUB-FAMILY OF THE PLOVERS.—THE TRUE PLOVERS (*Charadriinæ*).

The Lapwings (*Vanellus*), the Sand Plovers (*Ægialitis*), the Grey Plover (*Squatarola*), and the Golden Plovers (*Charadrius*), are the best known members of the present sub-family, which is distinguished by not having a hind toe, or at most a very small one. The Lapwings have long crests, which they elevate or depress at pleasure, and they are also remarkable for their enormous rounded wings. These are the birds which lay the "Plovers' eggs," so often used for the table during the spring, and large numbers are still sent up to London, notwithstanding the prohibition set upon this practice by Act of Parliament. The Lapwing, or "Pee-wit," as it is generally called, is a familiar object in the early days of spring, when it may be seen flying round and round over the fields or downs, uttering the musical cry so peculiar to the species, and tumbling over and over in the air in the most curious fashion. The male bird is the most demonstrative, and while the hen walks or stands upon the ground, the cock bird circles overhead, flapping his broad wings, and suddenly dipping down in a headlong direction to where his mate is standing. The pair will then take wing together, and perform extraordinary evolutions in the air, very often feigning lameness, in order to draw away an intruder from the eggs. There is generally no nest, and the eggs are not easily found, being laid upon the bare ground in the hollow of a cut or furrow. If approached, the female will, on quitting the eggs, run along a furrow with her body close to the ground for some distance before taking flight, so as to deceive the observer as to the real position of the eggs. When the female is sitting, or the complement of the eggs is laid, she evinces great affection for them, and both parents wheel round and round uttering cries of distress. They are also crepuscular in their habits, and may be seen still on the wing in the gloaming, while their cry is often heard in the stillness of the summer night. In the autumn they frequent the vicinity of the shore in large flocks, the majority of which are composed of young birds, and they are also gregarious in the winter.

Perhaps one of the best accounts of the Plover's habits which can be found anywhere is that published by Mr. Henry Seebohm, in Dr. Dresser's "Birds of Europe," after his return from the expedition undertaken by himself and Mr. Harvie Brown, to the Great Petchora River in Northern Russia. During this celebrated excursion the travellers discovered a number of eggs of the Grey Plover (*Squatarola helvetica*), a species by no means uncommon in England during the spring and autumn migrations, but whose eggs were all but unknown. Altogether, the English travellers found

eleven nests with eggs, and also discovered the young in down. The accompanying extracts from Mr. Seebohm's account will give a good notion of the breeding habits of the Grey Plover:—"We arrived at Alexievka," he writes, "on the evening of the 19th of June, and on the 22nd crossed the river to the land of promise, the Aarka Ya of the Samoyedes, the Bolshia Semlia of the Russians, the mysterious tundra (a sort of ornithological Cathay) of our little party. We mustered seven altogether, our two selves, our interpreter, Piottuch, and our crew of four, two Russians, a Samoyede, and a half-breed. It was a bright warm day; the wind had dropped, and it was too early in the season for mosquitoes to be troublesome. The tundra forms the east bank



LAPWING.

of the Petchora; and we had to climb up a steep cliff (perhaps sixty feet high), a crumbling slope of clay-earth, sand, gravel, turf, but no rock. We then looked over a gently-rolling prairie country, stretching away to a flat plain, beyond which was a range of low, rounded hills, some eight or ten miles off. It was, in fact, a moor, with here and there a large flat bog, and everywhere abundance of lakes. . .. . We had not walked more than a couple of miles inland before we came upon a small party of Plovers. They were very wild, and we found it impossible to get within shot: but a distant view through our binocular almost convinced us that we had met with the Grey Plover at last. We had not walked very far before other Plovers rose; and we determined to commence a diligent search for the nest, and offered half a rouble to any of our men who should find one. Our interpreter laughed at us, and marched away into the tundra with a 'C'est impossible, monsieur!' We appealed to our Samoyede, who stroked his beardless chin, and cautiously replied 'Mozhna.' The other men wandered aimlessly up and down, but the Samoyede tramped the ground systematically, and after more than an hour's search found a nest on one of the

dry tussocky ridges intersecting the bog, containing four eggs about the size and shape of the Golden Plover's, but more like those of the Lapwing in colour. The nest was a hollow, evidently scratched, perfectly round, somewhat deep, and containing a handful of broken, slender twigs and reindeer-moss. . . . Our seventh and eighth nests of the Grey Plover we took on the 9th of July. We set sail at noon, with a north-east wind, to visit the tundra eight or ten versts higher up the great river. For some distance before we landed the coast was very flat, with willows down to the water's edge. Among these dwarf trees we repeatedly heard the Petchora Pipit (*Anthus seebohmi*), and the Siberian Chiffchaff (*Phylloscopus tristis*). As soon as we got beyond the willows we landed on the tundra, and started in pursuit of a large flock of Buffon's Skuas, but were soon stopped by a pair of Grey Plovers, which showed by their actions that we were near the nest. We lay down as before, about forty or fifty yards apart, and watched the birds. They ran about, up and down, and all round us; and at the end of half an hour we were no wiser than at first. There was evidently something wrong. Harvie Brown then shouted to me, 'Have you marked the nest?' I replied by walking up to him and comparing notes. We then watched for another half hour with exactly the same result. I suggested that we must be so near the nest that the bird dare not come on, and advised that we should retreat to the next ridge, which we accordingly did. We had not done so many minutes before the female made her way on to the ridge where we had been lying. She then ran along the top of the ridge, passed the place where we had been stationed, and came down the ridge on to the flat bog towards where we then were. I whispered—'She is actually crossing over to us!' Suddenly she stopped, lifted her wings, and settled down on the ground. . . . Harvie Brown lifted his gun to his shoulder. She ran off the nest to the top of the ridge till he tumbled her over. We then walked up to the nest, the first we had seen on the flat. The eggs were quite fresh, or nearly so; and the nest must have been made nearly a fortnight later than those we had previously taken. During that time the bogs had become much dryer, so that we could cross them without much difficulty; and this would probably be the reason why this nest was placed lower down. The eggs had all the appearance of a second laying, being less blotched than usual, one of them remarkably so. It is worth noticing that whilst we were watching in our first position, very near the nest, the birds were nearly quite silent, and did not call to each other as they usually do.

"Our ninth nest of the Grey Plover we took on the 12th of July. A stiff warm gale from the east, with occasional smart showers of rain, kept the air clear of mosquitoes in the morning. In the afternoon the wind fell, and the mosquitoes were as bad as ever, but we were too busy to heed them much. At eleven we crossed to the tundra. We soon came upon a pair of Grey Plovers, which rose a couple of hundred yards ahead of us, their wings glittering in a gleam of sunshine after a smart shower. These birds have frequently a very curious flight as they rise from the nest, tossing their wings up in the air, reminding one somewhat of the actions of a Tumbler Pigeon. We lay down, as near the nest as we could tell, near the spot from which they rose, and were somewhat puzzled at their behaviour. The male seemed as anxious as the female, if not more so, running about as much as she did, continually crying, and often coming very near us, and trying to attract our attention by pretending to be lame. The female rarely uttered a note. We suppose this must have been because one of us was too near the nest. Harvie Brown moved his post of observation, after we had spent some time without being able to discover anything; and then the female behaved as usual, and I soon marked the position of the nest. We walked straight up to it, and found the four eggs chipped for hatching. We had no difficulty in shooting both birds, and afterwards hatched out two of the eggs, obtaining a couple of good specimens of young in down. With a little practice this mode of finding birds' nests becomes almost a certainty. One has first to be quite sure which is the male and which the female. When the birds are near enough, and one can compare them together, the greater blackness of the breast of the male is sufficient to distinguish him; but we found that the females varied considerably in this respect, and that it was better to notice the habits of the birds. The female usually comes first to the nest, but she comes less conspicuously. She generally makes her appearance at a considerable distance, on some ridge of mossy land. When she has looked round she runs quickly to the next ridge, and looks round again, generally calling to the male with a single note. The male seldom replies, but when he does so it is generally with a double note. When the female has stopped and looked round many times, then the male thinks it worth while to move; but more

often than not he joins the female by flying up to her. The female very seldom takes wing. She is very cautious, and, if she is not satisfied that all is right, will pass and repass the nest several times before she finally settles upon it. She rarely remains upon the post of observation long, but the male often remains for ten minutes or more upon one tussock of a ridge, watching the movements of the female.

"We walked some distance before we came upon a second pair; but at length we heard the well-known cry, and got into position. We spent nearly two hours over this nest, and were quite at sea by the end of the time. We changed our position several times, but to no purpose. The female went here, and there, and everywhere, as much as to say, 'I'm not going on to the nest as long as you are near.' At last the mosquitoes fairly tired us out, and we gave up the watching game, and commenced a search. We soon found out the secret of the bird's behaviour, when we picked up some broken egg-shells, and concluded at once that the bird had young. We tried to find them, but in vain. These two hours, however, were not wasted. The birds came nearer to me than they had ever done before. I often watched them at a distance of not more than ten yards, and was able to hear their notes more distinctly. The note most frequently used is a single plaintive whistle, *köp*, long drawn out, the *ö* pronounced as in German, and the consonants scarcely sounded. This, I am almost sure, is the alarm-note. It is principally uttered by the female when she looks round and sees something that she disapproves of. If the male shows any anxiety about the nest, which he seems to do more and more as incubation progresses, he also utters the same note. The double note, *kl-ee* or *kleep*, the *kl* dwelt upon, so as to give it the value of a separate syllable, is also uttered by both birds. It is evidently their call-note. I have seen the female, when she has been running away from the male, turn sharp round and look towards him when he has uttered this note, exactly as one might do who heard his name called. Whilst we were watching this pair of birds a couple of other Grey Plovers came up, and called as they flew past. The male answered the call and flew towards them. On the wing this whistle is lengthened out to three notes. I had some difficulty in catching this note exactly. It is not so often uttered as the two others I have mentioned, and is generally heard when you least expect it; but I am almost sure it is a combination of the alarm-note with the call-note *kl-ee-köp*. If I wanted to make a free translation from Ploverski into English, I should say that *kl-ee* means 'Hallo! old fellow!' and *köp* means, 'Mind what you are about!'"

Mr. Seebohm's notes, of which the above are only a fraction, also give accounts of other Wading-birds and Plovers which he met with during his adventurous journey, but they are too long to be quoted here. The Asiatic Golden Plover (*Charadrius fulvus*) is a bird which in appearance is a slender long-legged form of the common Golden Plover (*Charadrius pluvialis*). To the naturalist the Grey and Golden Plovers are easily distinguishable, for on lifting the wing the black axillary feathers of the Grey Plover are very striking, these being white in the Golden Plover, and smoke-grey in the Asiatic Golden Plover. The colour of the axillary feathers is a useful character in distinguishing the young birds, as the Grey Plover in its first autumn plumage is spotted with golden, and might easily be mistaken for a Golden Plover. The Sand Plovers (*Ægialitis*), of which the common Ring Dottrel (*Æ. hiaticula*) of England is a type, have similar habits and food to the larger species spoken of above, but they frequent more the beach and sandy shores of the sea, lakes, and rivers, laying four eggs in a slight depression in the sand, and the young, when first hatched, run about, and on the approach of danger squat down, when the assimilation of their colour to the surrounding shingle or sand serves to conceal them admirably.

THE THIRD SUB-FAMILY OF THE PLOVERS.—THE OYSTER-CATCHERS (*Hæmatopodinæ*).

The Oyster-catcher, or Sea Pie, as it is often called, from its black and white coloration, is often seen in England in considerable numbers on the shore, or in small parties of five or six together, in the autumn. These latter generally consist of a family of birds, which have been hatched in the more northern parts of England, and are now on their way southward. Single birds are by no means difficult to obtain at that season of the year, as their whistle can be easily imitated, and thus the bird can be attracted within range. In April the flocks disperse for the breeding-season, the Oyster-catcher nesting on the rocky shores near the sea, generally in unfrequented places. It is one of the handsomest of the Waders, being of a black and white colour, with a red bill and purplish-red legs.

Oyster-catchers are found in nearly every part of the world, and in the southern parts, that is, in South America, South Africa, and Australia, there are three species, which are totally black in colour.

THE FOURTH FAMILY OF THE WADING BIRDS, OR GRALLÆ.
THE BUSTARDS (*Otididæ*).

There is so much that is like a Game-bird in the Bustard, that it may well be considered to form a link between the *Gallinæ* and the Plovers. In the present family the general tone of the plumage is sandy-coloured, vermiculated with blackish lines and cross-markings. The gape is very wide, the mouth being cleft to beyond the region of the eye; the toes short and thick. The bill is in every instance

THICK-KNEE, OR STONE CURLEW.

short, and the wing is short and convex, the central quills being shorter, and the secondaries nearly equal in length to the primaries. The tail is always large, and there is no hind toe. The most Plover-like of the family of Bustards are the Thick-knees, or Stone Curlews (*Œdicnemus*), and the Coursers (*Cursorius*). The first of these genera occurs in nearly every part of the globe, and the members of it are remarkable for their more pointed and Plover-like wing, while they have the toes united at the base with a web. The eye is also very large, and the tarsi are reticulated. They frequent downs and large waste lands in England, indeed the English species (*Œdicnemus crepitans*) is often called the Norfolk Plover, as it is in that county that it is still principally found. We have, however, noticed a pair for several successive years on the Hampshire Downs. They inhabit desert places generally, and are very shy, being strong of flight, whilst they also run with great speed. The Coursers (*Cursorius*) differ from the Thick-knees in having the tarsi covered with transverse scales in front, while they are altogether smaller birds. They frequent the deserts, and are not found in northern parts of the globe, nor do they occur in the New World. From the similarity of colouring which these birds exhibit to the sandy wastes they inhabit, they are with difficulty observed, and their shy disposition makes them hard to obtain. This is more especially the case with the Cream-coloured

GREAT BUSTARD.

Courser (*Cursorius isabellinus*), a species which has occasionally wandered to England. Jerdon says that the Indian species (*C. coromandelicus*) is very abundant in the Deccan and Western India. It associates in small flocks, frequenting the barest plains and ploughed lands, and is very abundant on the parade ground at Jalna. It runs about rapidly, nodding its head occasionally when it stops, and picks up various insects, chiefly Coleoptera and the larvæ of certain grasshoppers. Burgess states correctly that it has the peculiar habit of running for a distance at speed, suddenly stopping, erecting the body, and then starting up again. It breeds on a hollow in the ground, from March to May, laying generally three eggs of a pale greenish-yellow colour, much blotched and spotted with black, and with a few dusky olive spots. It is rather a silent bird.*

The True Bustards are much larger birds than the Thick-knees, or Coursers, and have no basal web to the toes, the claws being stout, obtuse, and very short. The males are larger than the females. The Great Bustard (*Otis tarda*) used to be found on the fen lands and plains in England, but has been banished by the increase of drainage and the extension of civilisation. In many parts of Europe, however, it is still plentiful. The following short sketch of this bird has been condensed from Dr. Brehm's account of the species :—

It is found in Germany, and also frequents the south and east of Europe. Africa, with its flat deserts, gives it shelter, as well as Central Asia. The handsome, muscular form, and its many characteristics, combine to make it a most interesting bird, and, perhaps, also the difficulties experienced in its capture make a knowledge of its economy still more desirable. On occasions when it extends its finely-developed tail, and distends its neck, with its prominent moustache, it has a most dignified appearance. The female is much smaller than the male, though specimens vary according to age; a full-grown male will measure 3ft. 6in. from the tip of the beak to the end of the tail, and 8ft. from wing to wing. The pouch attached to the throat of the male is filled with air, allows the neck to be distended, and is also asserted to be a medium of strength to his voice, when he puts special pleading in his wooing. The plumage is varied; yellowish on the upper parts, varied with wavy lines of black, the under parts pale clay colour, the head and part of the breast ash-grey, the tips of the tail-feathers and some of the wings white, and the pinion feathers black. The Bustard, to secure a resting-place far from the haunts and attacks of men, displays immense intelligence; its caution and sagacity are most extraordinary, and it is amusing to notice how it will take advantage, for future benefit, of past experiences and escapes, and a lesson is never allowed to pass unheeded. Large, flat, open plains are its favourite haunts, and in selecting such spots it shows its wisdom, as there the approach of the hunter is easily detected, and even in Africa, where they sometimes live among high grass, they contrive to elude the enemy. One would suppose that when the bird is asleep it might be surprised; not so, however, for two old wary sentinels keep guard, and are always on the alert. The nesting-places are also fixed in very remote spots. They have a powerful agent in their splendid sight, and they are so clever that if they see anybody approach, who does not seem to have any particular business, no matter how much disguised, they take fright, and off they go. They may even have inhabited a chosen spot for some time, and yet, if they fancy that there is a little change in the familiar look of the place, they shift their quarters at once. Their sense of smell and hearing is less acute, and thus they may be captured by some skilful tactics, as, for instance, a covered pit, where the hunter is invisible, or a hut constructed during the last seed-time, into which the hunter introduces himself, and bags his prize as the Bustard walks comfortably past. The movements of this species are very quick, and it walks immense distances. Some assert that it experiences difficulty in preparing for flight, but this is not the case, for it flies very rapidly in the air, and gets its impetus by a short run. One can easily imagine that great *finesse* is required in their capture, firearms alone being of any use. We must now notice the food, habits, and maternal instincts of this bird. The food consists of various insects, all kinds of plants, seeds, fruits, &c. Green food is a favourite diet in summer, and to some extent in winter; but at this season it makes the rape-fields the scene of its operations, grazing in them at intervals during the day, and flying off at evening time to roost quite two miles away. It resembles the Goose in the manner of its grazing, and also in the way it cleans its feathers with dust. It also improves digestion by means of small stones, &c., which it swallows in great

* "Birds of India," Vol. II., p. 627.

numbers. Its wooing gives it an opportunity to show fresh qualities. This important affair comes off in the month of February, and at this time of year the Bustard feels very unsettled and unsociable; he quits his companions, and puts on his best appearance for conquest. Not the least part of the wooing is the combat that he often has with rivals on the way, and the struggle between these competitors for the fair one's regard is fierce and bitter. As they go struggling in the air they look like some birds of prey. The victor, of course, is rewarded with his spouse, and off they go together, to establish a home and found a family. The hen bird alone sees after all the business of incubation, the male meanwhile guarding her, and remaining true to his love. In a small hollow scraped in the ground two rather large eggs are deposited about the beginning of May; they are of a pale greenish tint. If these eggs are touched by man they are quite forsaken, unless so nearly hatched that the maternal instinct is aroused, and she completes the process. The chicks gather strength after a few days, and at the third week change their down for feathers, and at the fourth are ready to fly. Their food, supplied by the loving mother, consists of little insects, grasshoppers, &c. Ants' eggs are esteemed a great delicacy. It is a pity that these little things are liable to the attacks of Kites and Goshawks. The mother does her best to shield her precious ones, and often successfully, but, alas! when Eagles and Foxes catch sight of this tempting food, the mother's efforts are too weak, and many fall victims. We have heard of a Bustard attaining the age of fifty years, and even more; so they seem to know how to take care of themselves. As to Bustards being tamed, it is possible. We read of one being kept in a house at Khartoum, and enjoying the society of its owner. The adult Bustard, when imprisoned, requires plenty of space to take his pleasure, and show himself off, but in the Zoological Gardens the male may occasionally be seen in the spring time going through the most extraordinary positions, unexcelled for a love-display by any of the game-birds. The pouch under the tongue, which is supposed to add to the appearance of the bird by being inflated at will, is by no means present in every specimen dissected, and its exact use and object do not yet seem to be clearly defined.

THE FIFTH FAMILY OF THE GRALLÆ, OR WADING BIRDS.

THE CRANES (*Gruinæ*).

The Cranes may be subdivided into three sub-families, the Kagus (*Rhinochetinæ*), the Sun Bitterns (*Eurypygiuæ*), and the true Cranes (*Gruinæ*). The Kagus are represented by the single species *Rhinochetus jubatus*, of New Caledonia, the *Eurypygiuæ* also by a single species (*Eurypyga helias*) from South America. Professor Sundevall places the singular Australian bird, *Pedionomus torquatus*, of Gould, along with the Kagu in the first-named sub-family. Both the Kagu and the Sun Bittern may generally be seen living in the Zoological Gardens, and they go through, even in captivity, the extraordinary antics which seem to be characteristic of the Crane family throughout the globe. The true Cranes (*Gruinæ*) are found in almost every part of the world, with the exception of South America, and are birds of stately form and grand demeanour, though their habits of bowing and dancing, which they indulge in both in a state of nature and in captivity, tend to make them occasionally somewhat ridiculous.

THE COMMON CRANE (*Grus cinerea*).

This is a rare visitor to England, though it has been stated to have bred in the fen-lands in years gone by; at the present day, however, it occurs only accidentally. In the continent of Europe it is a regular summer visitor, breeding in marshy places in the more northern parts, and occurring in the south on migration, when the flocks pass in the form of a triangle, or in a straight line. In captivity the Crane not only becomes very tame, but displays great intelligence, as may be imagined from the celebrated story related by Dr. Brehm in his "Bird Life," of a domesticated Crane belonging to Von Seyffertitz, who gives a most interesting account of some young birds which he had. A few extracts from this story are given to illustrate the sagacity which the Crane displays:—"The extraordinary cleverness and trustful character of my young Cranes," writes Von Seyffertitz, "have reached such a degree of cultivation, that they engage the attention and awake the astonishment of all who see them. In a very short time they not only lost all fear of man and domestic animals, but even sought the companionship of the former. They knew

exactly all the houses in the place where the inhabitants had once given them anything, and never omitted to pay them a daily visit. Without the slightest timidity they entered the lower rooms of our house, often remaining there some time, and feeding out of the same dish with a very large Pointer. I fed them three times a day, and they were thoroughly aware when this took place. They arrived at the proper time, and announced themselves by screaming. If the time seemed too long they marched into the kitchen and waited by the fire until their dinner was ready. They would accompany me and others in our walks, following us like dogs; sometimes taking a flight they gambolled about in the air, alighting occasionally, and then continued to accompany us. It was a pleasure to have these charming creatures about us." One of them having perished by an accident, the survivor consoled himself by a greater activity of life. "As it was out of my power," continues the narrator, "to replace the loss he had sustained by another of his own species, he helped himself. He chose a fresh companion, with whom he contracted a new friendship, which still exists. You will hardly imagine the one he chose from among the many creatures surrounding him. It was none other than a bull on our estate. How, and from what reason, the friendship sprang up, I cannot exactly make out, though it appears to me that the bull's loud bass voice produced some especial effect. To be brief, the two became fast friends ere spring time; the Crane accompanies his horned favourite daily to the pastures, and daily visits him in the stable. He treats him always with the most marked deference, and evidently considers him as his superior. In his stable he stands respectful and erect by his friend, as though obliged to await his orders, keeps the flies off him, answers when he roars, and takes every possible means to pacify his friend when enraged. When the bull is among the cattle in the yard he plays the part of adjutant, generally walking about two paces in his rear, often dancing round him, bowing respectfully, and, in fact, behaving in so droll and comical a manner that no one could look on without laughing. In the afternoon he follows the bull and the whole herd to the meadows, a distance of more than two miles, and returns with them in the evening. The bird generally follows some few paces in the rear of his friend, or else walks alongside of him, or suddenly precedes him and runs on twenty yards or more, and then, turning round, bows down before his august companion until the latter has come up with him. These proceedings are carried on through the whole village, to the intense amusement of the inhabitants, until the farmyard is reached, when, after repeated bows and demonstrations of affection, he takes leave of his respected companion." After relating how the Crane reigned supreme in the poultry-yard, and even took the horses and foals in hand and kept them in trim, the story continues:—"He keeps the cows and oxen in order, both in the yard and in the fields, and assists to drive them backwards and forwards, and always separates them if they take to butting one another. If they refuse to obey, he tries the effect of his loud ringing voice, which generally so alarms them that they speedily take to flight. In the fields he keeps the herd together, and prevents their getting into mischief. One evening he brought home, unaided, a whole herd of heifers, and drove them into the stables. This bird has undertaken so many jobs that he is employed the whole day long. Recently he returned to his other duties, after having assisted in driving the village herd of cattle to the pasture. In passing through the hamlet he found some heifers belonging to the herd which had remained behind, whereupon he instantly set about driving them down to those in the meadows. He drove them safely through the village, but frightened them so with his screams and blows with the beak, that they ran away, and took the contrary direction to where the rest of the herd had gone. He ran quickly after them to try and bring them back, but to no purpose. The chase continued for over two miles, finishing in a field of corn belonging to the neighbouring village, where the cattle and their feathered herdsman were pounded: the latter, however, would not allow himself to be caught, but returned home, disconsolate at his want of success. . . . To us he behaves in a most polite and amiable manner. When hungry, he generally presents himself under my mother's window, as she is exceedingly fond of him, and feeds him several times during the day. Here he calls; if he is not heard he enters the house, calling louder and louder, till at last he takes refuge in the kitchen, where he seeks his friend and caterer, the cook, to whom he details his requirements. He shows his pleasure at her appearance by uttering the familiar cry, *Coor, coor, coor, coor*, and makes her understand, by all manner of antics, how he wishes to be fed. If he wants bits of bread from the hand, which is his principal food, he points to it with his beak; should he, however, wish to be fed on the floor, he lays a piece down there, and then she must throw all the rest there. This bird always shows

DEMOISELLE, CROWNED, AND COMMON CRANES.

most obedience to my mother and her servant, and he misses the latter immediately she is absent, in which case he seeks her with the greatest diligence, stealing into the house and under her window, listening attentively for the sound of her voice or for her footstep, for he recognises the latter from afar. While young, she was always obliged to carry him to his sleeping-place, owing to his great dislike to going there himself. If the weather was bad he liked to be taken to bed early; if, on the contrary, it was fine, he would hide up in the evening at the approach of his keeper. Now he no longer seeks her assistance, but his friendship for her is still the same, and it is only when she allows him to call in vain for his food, when hungry, that he shows his displeasure."

THE SIXTH FAMILY OF THE GRALLÆ, OR WADING BIRDS.—THE TRUMPETERS (*Psophiidæ*).

This family of birds is entirely peculiar to South America; and only six species are at present known. They differ from the Cranes in having the bill much shorter than the head, the culmen being arched, and curving downwards at the tip. The plumage is very thick and close, and the wing is concave, fitting tight to the body; it is at the same time broad, the centre quills being only a little shorter than the primaries and secondaries. The tarsus is scaled both in front and behind. The Trumpeters inhabit the forests, frequenting the ground in search of grain and food. Their presence is often betrayed by their loud call, which has gained them the name of "Trumpeter."

CHAPTER IX.

THE HERONS—THE GEESE AND WILD FOWL—THE PELICANS—THE SEA-BIRDS.

THE HERONS—Characters—THE TRUE HERONS—THE COMMON HERON—Mr. Harting's Account of its Habits—Heronries—Egrets—Hungarian Breeding-places—Feeding the Young—THE STORKS—The Umbre, or Brown Stork—The Shoe-billed Stork—The Characteristic Bird of Central Africa—The White Stork—Protection afforded them in Various Countries—The Adjutant—The Marabou—THE SPOONBILLS AND IBISES—THE SPOONBILLS—Their Peculiar Bill—Habits—THE IBISES—Species—Dr. Brehm's Remarks on the Sacred Ibis—THE FLAMINGOES—THE GEESE AND WILD FOWL—THE SCREAMERS—WILD FOWL—Characters—THE GEESE—Dwarf Geese—Cereopsis Goose—Spur-winged Geese—Grey or Wild Goose—Sea Geese—Brent Goose—THE SWANS The Wild Swan—The Black Swan—THE DUCKS—The Wild Duck—The Mallard—SCOTERS—EIDERS—MERGANSERS—THE STIFF-TAILED DUCKS—The Diving Ducks—THE PELICANS—THE FRIGATE BIRDS—Habits—Visit to a Breeding place—Domesticated—THE TROPIC BIRDS—THE PELICANS—The Common Gannet—Visit to a Colony of Boobies—The Darter, or Snake-neck—The Cormorants—A Colony of Cormorants—The Pelicans—Characters—Habits—Perching on Trees—Fishing—THE SEA-BIRDS—Characters—THE SCISSOR-BILLS, OR SKIMMERS—THE TERNS OR SEA-SWALLOWS—"Wide-awake Fairs"—White Noddies—THE TRUE GULLS—Characters—The Black-backed Gulls—Herring Gulls—Skuas—THE PETRELS—Distribution—The Diving Petrel—The True Petrels—The Albatrosses—Capt. Hutton's Remarks on their Unrivalled Powers of Flight.

THE SEVENTH ORDER OF BIRDS—THE HERONS (*Herodiones*).

In the order of Heron-like birds the nostrils will be found to be small, placed rather high in the mandible, the bill being at the same time very hard and horny. The bill is longer than the head, and is united to the skull by firm, broad bones. The wings are always of large size. As a rule, the Herons are big birds, and make their nests in trees, whither they bring food to their young, who remain for some time in the nests, and are not able, like the majority of Wading-birds, to provide for themselves when they are hatched. They are also covered with down of a long, loose character, and they have large crests of down on the head when in the nest.

THE FIRST FAMILY OF THE HERODIONES.—THE TRUE HERONS (*Ardeidæ*).

The true Herons may be distinguished by their large hind toe, which rests on the ground like the others, and is furnished with a very big claw, or nail, which is equal in size to the claw of the middle toe. The latter has a pectinated or comb-like edge on its inner margin. The wings are very large and the flight is slow. The lores and region of the eye are also bare.

THE COMMON HERON (*Ardea cinerea*).

Much might be written about the habits of this interesting bird, as many excellent accounts of its habits have appeared in ornithological works, but nowhere, perhaps, has a better idea of

the habits of the Heron been given than that by Mr. Harting, in his "Hints on Shore Shooting."

"On most parts of the coast the Heron may be seen at low water, fishing in the little pools which have been left by the receding tide. Here he finds crabs, shrimps, and other delicacies; but instead of being sociable, like the Gulls and Redshanks, and inviting a friend to join him

GREAT WHITE HERON.

at dinner, he goes to his own particular pool, like an old gourmand to his club, and keeps the best of everything to himself.

"We have watched him on the rocky weed-covered shore of Northumberland, on the shining sands of Lancashire, and on the dreary mud-flats of the Sussex harbours, and have found him always the same; shy and suspicious, even when seldom disturbed he seems to have a wonderful eye to danger, and we almost believe can distinguish a gun from a stick or an umbrella.

"Now and then, upon a rocky coast, we have stalked him under cover of a friendly boulder, and while our heart beat loud with rapid exertion and excitement, we have shot him just as he had detected our head above the rock. And what a triumph we have felt in standing over his prostrate form, and smoothing his expansive wings, feeling in that moment a sufficient reward for having

crawled, on hands and knees, perhaps three hundred yards of treacherous ground, slipping over sea-weed, and through salt-water pools! But it was never thus on the mud-flats; there no friendly barrier intervened to screen our approach, and we could advance only near enough to be just out of shot, when the large wings were unfolded, and we were left to stand and gaze wistfully after the coveted prize. Now and then, at early dawn, we have come suddenly upon a Heron while busily employed under the steep bank of a brook, and have thus been enabled to knock him down with snipe-shot before he could get out of range. It was ludicrous to observe the surprise of the bird when he first became aware of our presence, and with a hoarse croak clumsily endeavoured to get away. On

PURPLE HERON.

one occasion, accompanied by a red Setter, we were stalking a Heron, when the dog, over anxious, ran forward, and attracted the attention of the bird, which immediately took wing. Instead of flying away, however, he hovered over the dog, looking down at him like a Hawk. We crouched down, and gave a low whistle, and the dog, coming back, actually brought up the Heron within shot, when we fired and killed him. The bird seemed to follow every movement of the dog, and was so intently eyeing him, that he never saw us until the gun was raised. He then turned at once to make off, but too late.

"On the coast the Heron feeds at low water during the day, and in unfrequented marshes he may also be caught fishing in broad daylight; but when compelled to get his living at reservoirs, ponds, and rivers, which are oftener visited by his enemy, man, he prefers to come just before daybreak or after dusk. In autumn, when the brooks run dry, we have frequently noticed the impressions of his long toes, visible for miles on the soft mud, showing the great extent of ground traversed in his patient search for food. Fish, frogs, mussels, and even water-rats, are all included in the Heron's bill of fare.

He will take young water-fowl, too, from the nest, and after pinching them all over in his formidable bill, and holding them under water till they have become well saturated, he throws up his head, opens his mandibles, and the 'Poule d'eau souchée' disappears.

"Some years ago we paid a visit, in the month of May, to a certain reservoir in Yorkshire, where the Pochard (*Anas ferina*) was known to have bred, our object being to ascertain whether this duck was then nesting there, and to learn what other fowl were on the water. We might say a good deal of that pleasant excursion, but must confine our attention for the present to the Heron. At one end of the reservoir is, or was, a thick belt of willows, extending out some distance from the shore. The

NIGHT HERON.

water at this spot is shallow, with a muddy bottom. Coots and Moor-hens were numerous and noisy, swimming about amongst the willows, and collecting materials for their nests. We lay upon the grass at the edge of the water, peering quietly through the willows, and learnt a great deal of the private life of these water-fowl. While we were gazing, a Heron, which must have flown unnoticed up the water, dropped suddenly in the shallow, within twenty yards of our ambush. Here was an opportunity for observation. Scarcely venturing to breathe, we watched with interest every motion of the great grey bird. His long black crest and pendent breast-feathers showed him to be fully adult, and we thought at the time we had seldom seen a Heron in finer plumage. With head and neck erect, he took a cautious glance all round, as if to satisfy himself that he was unobserved, and apparently assured, he then looked down at the water. For some minutes he never altered his position, till at length, bending slowly and gracefully forward, he suddenly struck the water with his bill, and recovered a small fish. A pinch, a toss of the head, and it had disappeared down his throat. He then drew himself together with apparent satisfaction, wiped his bill upon his long breast-plumes, and slightly altering his position,

prepared, as an angler would say, to make another 'cast.' At this moment we incautiously moved a little to one side to avoid a willow-bough, and obtain a better view, when his quick eye instantly detected the movement, and in another second he was flying down the water in the direction whence he had come. There are few sights more gratifying to a naturalist than a heronry. We have had the privilege of visiting three, one at Walton Hall, Yorkshire, the seat of the late Charles Waterton; one at Milton, near Peterborough, belonging to the Hon. George Fitzwilliam; and one at Wanstead, the property of Lord Cowley. Did space permit, we might give a detailed and interesting account of all we saw on these occasions, but we can do no more than offer a few brief remarks on the general appearance and situation of the heronry last named.

"The date of our visit was the 5th of April, and the birds were then sitting on their eggs. The Heron is one of the few Waders which resort to a tree for the purpose of nidification, and a stranger sight than a number of these great birds can scarcely be imagined. Twenty years ago, the Herons at Wanstead Park tenanted some trees at a different spot to that which they now frequent. At present they occupy some tall elms upon an island in the largest piece of water in the park. The keeper informed us that there were about thirty pairs. We proceeded to the boat-house, and after bailing out the boat, which was nearly full of water, steered for the Heron's island. A good glass enabled us to see the birds very clearly, and most of them were in splendid plumage. The nests were placed at the very top of the trees, and many of them were occupied by a sitting bird.

"Here and there a Heron stood erect upon a bough, with head and neck drawn in, looking for all the world like a cold sentinel, with his bayonet between his teeth, and his hands in his trousers pockets. As we approached the island, several loud croaks were heard, and the sentinels took wing, the sitting birds being the last to leave. Taking it for granted that the bird which sat the longest was the most likely to have eggs, we selected a tree from which a Heron flew as we reached it. It was a wych elm, about forty feet high, and the nest was placed amongst the topmost branches. After a fatiguing climb, owing to the absence of boughs for a considerable distance, we reached the top, and paused to rest before looking into the nest. And now was the anxious moment. Were our exertions in vain? Was the nest empty, or were we to be rewarded with the sight of eggs? The nest was large enough to sit in, composed externally of large twigs, chiefly elm and willow, and lined with smaller twigs, fibre, and dry grass. It overhung our head to some extent, so that we were obliged to pull away a portion of the side before we could see into it, when, to our delight, four beautiful eggs were displayed, their bright bluish-green colour contrasting well with the dark fibre on which they were laid.

"The wind blew in gusts, and it was no easy matter to get them down safely; but at length we succeeded in getting them into our handkerchief, and holding the ends together in our mouth, brought them down without a crack. They were considerably incubated, showing that they had probably been laid about the end of the third week in March. The Heron, indeed, is one of the earliest birds to breed. The young, when first hatched, present a very remarkable appearance, and are fed by their parents for a long time before they can shift for themselves.

"A friend once kept a Heron on his lawn, and a very amusing bird he was. When first captured he was very sulky and refused all food. Fearing he would starve, the owner forced some fish down the bird's throat, but the next moment saw it returned upon the grass. The process was repeated, with the same result, and a third time my friend endeavoured ineffectually to overcome the obstinacy of his captive. At length, reflecting how the Chinese treat their tame Comorants, by fastening a strap round the neck to prevent the fish from going down, he tied a piece of tape round the Heron's throat, to prevent the fish, in this case, from coming up. The experiment was perfectly successful, and the bird, finding it impossible to disgorge, at length abandoned the attempt, and subsequently fed himself. Fish were placed for him in a fountain on the lawn, and he evinced great delight in taking them from the water. One day a rat was observed helping himself to the Heron's food. The rightful owner caught him in the act, and with one blow of his formidable bill felled him to the ground. Seizing him, then, before he could recover, he carried him squeaking to the fountain, and ducked him. After shaking him well under water, he held him up for examination. The rat spluttered and squeaked in abject terror, and again was he submerged. The dose was repeated, until the unfortunate rat at length succumbed, and being by this time nice and tender, the Heron pouched him, and his thin, elongated

form was seen distending the thin skin of the bird's neck in its passage downwards, until it finally disappeared for ever."

The writer remembers, as a boy, paying a visit to Lord Fitzwilliam's heronry, at Milton, near Peterborough, one of the breeding-places mentioned by Mr. Harting in the foregoing account. On many of the nests, which were placed at the top of some high trees, two birds were sitting side by side, silent and unmoved as statues, save for the rocking which the gale of wind gave them. It was blowing hard at the time, and many nearly full-grown young birds were on the ground walking about, whilst

LESSER EGRET.

not a few were entangled in their fall among the branches, and were liberated by us youngsters, not without fear of an attack from the old birds, who croaked most ominously above our heads.

The general colour of the Heron is grey above, white underneath, the breast black, with a white patch in front. The throat and fore-neck are white streaked with black. On the head is a beautiful pendent crest of black plumes. The forehead is white.

Among the other species of the genus *Ardea* are the Egrets, most of which have snowy-white plumage, with beautiful long crests and feathery plumes on the back during the breeding-season. More than one species has occurred in England, but they are much more plentiful in certain parts of the continent.

In Hungary large numbers of Herons and Egrets breed together in the marshes, Egrets and Night Herons (*Nycticorax griseus*) herding together with Common and Purple Herons. Landbeck

writes :—"The clamour in these breeding-places is so tremendous and singular in its character as almost to defy description : it must be heard before a person can form any idea of what it is like. At a distance these hideous noises blend into a confused roar, so as in some way to resemble the hubbub caused by a party of drunken Hungarian peasants ; and it is only on a nearer approach that the separate notes of the two species, the Common and the Night Heron, can be easily distinguished, namely, *craik* and *quâck*, to which the notes of the young, *zek-zek-zek*, or *gek-gek-gek*, &c., in different keys, serve as an accompaniment. When close to, the noise is tremendous, and the stench unbearable. This, together with the sight of dozens of young Herons in every stage of putrefaction and teeming with maggots, is perfectly sickening, though the contemplation of life and movement in this immense heronry is a matter of interest to the true ornithologist."

The tops of the highest trees are usually occupied by the nests of the Common Heron ; a little lower down is the habitation of the shy and beautiful Great Egret (*Egretta alba*) ; while among the forks of the lowest branches the Night Heron takes up her abode. All these species build in one and the same tree, the nests numbering not unfrequently as many as fifteen in a single tree, and yet peace invariably reigns between all these varieties. High over the trees appears the Common Heron, laden with booty, announcing his arrival with a hoarse *cruaich*, when, changing his note to a goose-like *da-da-da-da*, he either jerks the provender down the throats of his ever-hungry youngsters, or throws it up before them, when the fish are greedily swallowed amid a desperate accompaniment of *gohé-é-é-é, gohé-é-é-é*, a sound much resembling the frantic cry of a calf which is being lifted into a farmer's market-cart. The conduct of the more cautious Egret is very different. Circling far above the nest, she first satisfies herself that no foe is hidden below before she alights amongst her family, which are much quieter and less hasty than their cousins. The Night Herons, on the contrary, approach their nests from all sides, high and low, their crops filled with frogs, fish, and insects. A deep *quâk* or *gowek* announces the arrival of the old bird already from some distance, to which the young answer while feeding with a note resembling *queht, queht*, or *quehaoôheh, quehoehah*. As soon as the parents have taken their departure the youngsters recommence their concert, and from every nest uninterrupted cries of *tzik-tzik-tzik, tzêk-tzêk-tzek, tzgê-tzgé-tzgé*, and *gêtt-gêtt-gêtt*, are the order of the day. This amusement is varied by the nestlings climbing out among the branches till they reach the top of the tree, whence they can have a good look-out, and can see the old birds returning home from a long distance, though they are in many cases often mistaken as to their identity.

THE SECOND FAMILY OF THE HERODIONES.—THE STORKS (*Ciconiidæ*).

These birds may be divided into two sub-families, the Umbres (*Scopinæ*) and the true Storks (*Ciconiinæ*). The first of these sub-families contains only two genera peculiar to Africa, each possessing a single species as its representative. The Umbre, or Brown Stork, is a bird of moderate size, with a totally brown plumage and a well-developed crest. Mr. Layard writes of it :—"The Hammer-kop (literally Hammer-head) is found throughout the Cape Colony, and all the way up to the Zambesi, frequenting ponds, marshes, rivers, and lakes. It is a strange weird bird, flitting about with great activity in the dusk of the evening, and preying upon frogs, small fish, &c. At times, when two or three are feeding in the same small pool, they will execute a singular dance, skipping round one another, opening and closing their wings, and performing strange antics. They breed on trees and rocky ledges, forming a huge structure of sticks, some of them of considerable thickness. These nests are so solid that they will bear the weight of a large, heavy man on the domed roof without collapsing. The entrance is a small hole, generally placed in the most inaccessible side." Mr. Layard also states that the bird embellishes his singular nest with brass and bone buttons, bits of crockery, bleached bones, or anything bright and glittering which it may pick up. One nest which he saw was three yards long, and one yard and a half across.

The *Balæniceps rex*, or Shoe-billed Stork, is less widely distributed than the Brown Stork in Africa, being only found in the waters of the Upper Nile, where he is very seldom met with, however. It is one of the largest birds known, and is unequalled among birds for its curious appearance. As to the distinctive birds of Central Africa, Dr. Brehm writes :—"A creature which resembles a very marvel of fairy-land—I mean *Balæniceps rex*, the Boot-bill, or Shoe-bill, as the Arab tribes of East Soudan call it—holds the first place among the characteristic birds of Africa : there is, in fact, only

SHOE-BILLED STORK.

one other species in Africa which is as remarkable as this—the Ostrich. It would indeed suffice if we were to take these two birds as types of Africa. One of them, the 'new wonder of the desert, the camel of birds, a bird which flies on its legs and steers with its wings, a winged Giraffe, which affords the Arabs matter for a thousand fables;' the other, 'the wondrous guardian of the holy stream which shrouds its source in secrecy,' in its origin a mystery, in itself a riddle. The sacred Ibis, no less a servant of the ancient god, added its long-established renown to the sacred stream. Legend has given the Boot-bill its celebrated name, a name as remarkable as the bird itself, while it has earned from the atmosphere of fable with which it is surrounded, owing to its fantastic form, 'the whale-head' and 'king!'—and verily with him the innermost and obscurest realm of the world is revealed." *

The true Storks have not the hooked bills which distinguish the foregoing birds; they contain the Adjutants, the Open-bills (*Anastomus*), and the Wood Ibises (*Tantalus*). The White Stork (*Ciconia alba*) is a summer visitor to Europe, and is seldom found in England. In many parts of the continent, however, he is by no means uncommon, and wherever they occur they are protected by the peasants on whose houses they build, and the nests are regarded in many places as a protection from fire. The migration occurs during January and February, when the Stork arrives in his winter quarters in South Africa, passing by the Strait of Gibraltar in vast numbers, some of them, according to Colonel Irby, remaining to breed in Morocco. These are the first to depart south. During the autumn migration a great many stop to rest on their southward journey, and are seen in considerable numbers, being very tame, and often following close behind the plough. M. Favier states that the Moors believe that it offends God to kill these birds, in the same way as they believe that it pleases or soothes the evil one to kill the Raven. The White Storks, in common with Swallows, are supposed to be inspired by Allah to protect the harvest and the country from noxious insects and reptiles, and the birds themselves (knowing the benefits they confer on man) ask in return protection for their offspring by building their nests on the walls of towns and houses. Another Arab legend is that the Storks originate from a wicked Kadi and his family, who, as a punishment for their great cruelty, were all changed into these birds, and that these *misérables* humble themselves to appease Allah, and in the hope of some day regaining their original human form, pray without ceasing day and night, and, whenever they rest, prostrate themselves and clack their bills.

Colonel Irby says:—"On the African side of the Strait of Gibraltar, in many situations, the Storks breed on trees, generally in colonies, as well as on houses, but usually near villages, and almost every Moorish hovel has its Stork's nest on the top, a pile of sticks lined with grass and palmetto-fibre. It usually contains four white eggs, which are very rarely marked with pink blotches; these are sometimes laid as early as the 25th of March, and are very good eating, either hot or cold. . . I may here remark that Storks usually migrate in large flocks at a great height, with a gyrating flight. The earliest date of their arrival that I noticed near Gibraltar was on the 11th of January; and they nearly all leave by the end of September. Feeding on insects of all kinds—mice, snakes, and other reptiles—they are most useful birds, and certainly deserve the protection and encouragement which they receive in Morocco, where they are in consequence excessively tame. Their grotesque actions when resting, and their habit of continually clacking their bills together, making a noise like a rattle, render them very amusing to watch. I was informed by a Frenchman who had passed two years in the city of Morocco, that there, as well as at Fez, and some other large towns in the Moorish Empire, there is a regular Storks' hospital, and that should one be in any way injured, or fall from the nest, it is sent to this institution, or rather, enclosure, which is kept up by subscription from wealthy Moors, who consider the Stork a sacred bird." †

Of the Adjutant (*Leptoptilus argala*) an excellent account is given by Dr. Jerdon in his "Birds of India":—"The pouch is sometimes sixteen inches and more in length. It has no connection with the gullet, but is probably connected with the respiratory system of the bird; and as Mr. Blyth suggested, is probably analogous to the air-cell attached to one lung only of the Python or Boa, and, as in that case, no doubt supplies oxygen to the lungs during protracted acts of deglutition. It appears to increase in size with the age of the bird.

"The Adjutant is found throughout the greater part of India, is rare in the South, but extremely

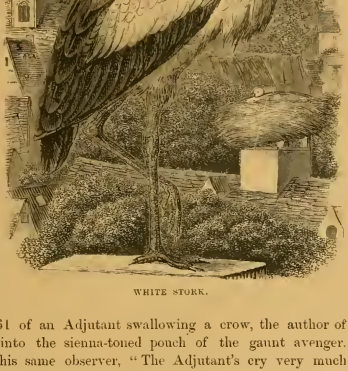
* "Bird Life," p. 192.

† "Birds of Gibraltar," p. 189.

FLAMINGOES. (*See pp.* 190-1.)

(*From the Living Specimens in the Zoological Gardens, London.*)

common in part of Northern India, and more especially in Bengal and North-eastern India. I never saw it in the Carnatic, nor in Malabar; it is occasionally met with in Mysore, and is not rare in Hyderabad, thence becoming more common and abundant northwards. It spreads through Burmah to the Malayan peninsula. It is only a temporary resident in India, coming in towards the close of the hot weather in April or May, and remaining till October. A very few barren or unpaired birds remain occasionally in parts of the country. In Calcutta, and some other large towns, the Adjutant is a familiar bird, unscared by the near approach of man or dog, and protected in some cases by law. It is an efficient scavenger, attending the neighbourhood of slaughter-houses, and especially the burning grounds of the Hindoos, where the often half-burnt carcases are thrown into the rivers. It also diligently looks over the heaps of refuse and offal thrown out in the streets to await the arrival of the scavengers' carts, where it may be seen in company with dogs, kites, and crows. It likes to vary its food, however, and may often be seen searching ditches, pools of water, and tanks for frogs and fish. In the Deccan it soars to an immense height in the air along with Vultures, ready to descend on any carcass that may be discovered. After it has satisfied the cravings of its appetite, the Adjutant reposes during the heat of the day, sometimes on the tops of houses, and now and then on trees, and frequently on the ground, resting often on the whole leg (tarsus). The Adjutant occasionally may seize a crow or a myna, or even, as related, a small cat; but these are rare bits for it, and indeed it has not the opportunity in general of indulging its taste for living birds, notwithstanding Cuvier's statement, 'that its large beak enables it to capture birds on the wing.'" Dr. Jerdon then mentions a description published in 1861 of an Adjutant swallowing a crow, the author of which account stated that he "saw it pass into the sienna-toned pouch of the gaunt avenger. He who writes saw it done." Again, wrote this same observer, "The Adjutant's cry very much resembles water flowing from a narrow-necked bottle, and he invariably utters it when about to swallow a piece of offal." "These utterly unfounded statements" called up Mr. Blyth in the "Ibis," Vol. iii., p. 268, who showed that both the passing of the crow into the pouch, and the call of the Adjutant, were simply impossible, in consequence of structural peculiarities. The Adjutant breeds in trees, on rocky cliffs, occasionally, it is said, in lofty trees away from hills. The neighbourhood of Moulmein is one of the best-known localities. The nests were found by Colonel Tickell on trees near the summit of some of the remarkable limestone rocky hills near that place. Captain Sparks had previously found the nest in the same locality; and Mr. Frith found them breeding in the south-east part of the Sunderbunds. The Adjutant lays two white eggs, and the young are covered with white down.



WHITE STORK.

"The feathers, known as marabou, or Comercolly feathers, and sold in Calcutta, are the under tail-coverts of this and another species [the Marabou Stork]. There is a popular superstition that if you split the head of this bird before death, you will extract from it the celebrated stone called Zahir mora, or poison killer, of great virtue and repute as an antidote to all kinds of poison."

THE THIRD FAMILY OF THE HERODIONES.—THE SPOONBILLS AND IBISES (*Plataleidæ*).

Although in outward appearance, at least, as far as their bills are concerned, the two groups of the Spoonbills and Ibises appear so different, yet they are closely allied on anatomical grounds, and

are to be considered as forming one family only. They may, however, be divided into two sub-families, as follows :—

THE FIRST SUB-FAMILY OF THE PLATALEIDÆ.—THE SPOONBILLS (*Plataleinæ*).

The extraordinary bill separates these birds from all their near allies. It is long and flat, widening out at the tip in a spoon-shaped apex, whence the birds derive their name. Only half a

SPOONBILL.

dozen species of Spoonbills are known to science, but the genus occurs in every quarter of the globe, excepting in the northern parts. Thus, it is not found in the north of Europe, and only in the southern states of North America. The Spoonbill comes to England now only as a straggling visitor, but was formerly more plentiful. It has, doubtless, retired on the draining of the fens, which rendered it difficult to find sufficiently suitable breeding-places. In Holland it still nests, though even there it is becoming rarer, as the lakes become drained. In certain places it is known to breed in lofty trees, but in Holland it nests on the ground among reed-beds, and an interesting account is given by Dr. Sclater and Mr. Forbes of a visit paid by them to a large mere called the "Horster Meer," between Utrecht and Amsterdam. The lake is farmed out at a considerable rent for the sake of the fish, reeds,

and eggs obtained there, and the nests of the Cormorants and Spoonbills are robbed systematically twice a week during the months of May and June. After that time they are left to hatch out their eggs. Several thousand nests of the Spoonbill were said to be in different parts of the mere at the time of the visit of the above-named gentlemen, and all those that they examined were simply flattened surfaces of broken reed, not elevated more than two or three inches above the level of the swamp. The eggs are white with a few pink or brown spots.

THE SECOND SUB-FAMILY OF THE PLATALEIDÆ.—THE IBISES (*Ibidinæ*).

As before mentioned the Ibises, though closely related to the flat-beaked Spoonbills, differ greatly from them in the form of the bill, which is curved like that of a Curlew. They are, moreover, more

SACRED IBIS.

numerous than the members of the preceding sub-family, about thirty species being known. These are found everywhere, excepting in the extreme north, some kinds being resident, whilst others are migratory. Some of the Ibises are very picturesque in colour, and the Scarlet Ibis (*Ibis rubra*) of South America is really a beautiful bird. The Glossy Ibis (*Falcinellus igneus*), which has occurred on rare occasions in Africa, is one of the most cosmopolitan of birds, being found in the greater part of the Old World and the New. The most interesting species, however, of this genus is, no doubt, the Sacred Ibis (*Ibis religiosa*), which is so well known to us as the bird worshipped by the ancient Egyptians, and so often figured on their monuments. It was to them the harbinger of the spring, and heralded the approach of the fruitful season. Brehm writes:—"Birds are perfectly aware that they can implicitly trust the Arab. No young scamp ever thinks of robbing their nest; no *sportsman* is lying in wait near their bower to kill the newly-fledged youngsters. In the eyes of the Arab, the naturalist, even, who only destroys an occasional pair

of birds, or takes an egg or two for the purposes of science, is not held to be excused. They have often called down the curse of heaven upon my head for so doing; and, indeed, my brown servants used to tremble for me, as they said that the curse was bound to take effect. I never abused them in return, for I could not but admire the feelings which inspired them on those occasions, sentiments so noble, and so deeply founded, that I have always dreaded the curse, despite of myself.

"In former days it may possibly have been thus in all countries. In those days all birds were loved and cherished by man, some being, indeed, regarded by him as sacred. He saw connected with their appearance and departure those various phenomena of nature which took place the year round, and whose changes, &c., they did not then understand: he regarded the arrival of the migratory visitors with holy awe, as though the Deity Himself had appeared. In this manner the Egyptians held the Ibis to be sacred. When the Nile, after being at its lowest ebb, rose again, and the water assumed a red tinge, then the Ibis appeared in the land of the Pharaohs as sure guarantee that the stream—the giver and preserver of life, which the people in their profound reverence raised to the rank of a god—would once again empty the well-spring of plenty over the thirsty land. The servant and messenger of this all-bounteous Deity commanded of necessity a reverence of a poetic and distinguished character, by reason of its importance: he, too, must also be a god! How beautiful, intelligent, and simple was this messenger! The Ibis is one of the most amiable and winning birds I have ever met with. It associates of its own accord so much with man that the trouble of taming the bird is but slight, and takes place almost without any advances on the part of the former. This the ancient Egyptians were fully aware of, for we find that they read the great book of nature with intelligence and care, and it is owing to this that they deified the bird. On this account its remains were preserved by their priests from decay, and kept for thousands of years, until the spirit, suffered by permission of an All-wise God to wander in space, should return to its earthly tenement. Like the human body, that of the bird was embalmed in the same spices in which the mortal remains of kings had been preserved from the ravages of time; and like them, over the sarcophagus a heap of stones was raised as a monument to the bird. One of the pyramids at Sakkara is dedicated to the Ibis.

"Now, the Ibis is no longer venerated; the sacred bird has sunk to the rank of an ordinary mortal. Isis and Osiris have been supplanted by the Crescent and the Cross; and with the ancient gods vanished Thot, their celestial messenger. He no longer appears in Egypt to announce to the people the rising of the sacred waters; they believe no longer in his mission. He lives retired far up the mighty stream, 'who hides his source,' as though he felt called upon to watch the veil behind which the origin of the ancient god lies hidden to this day. He lives, however, a thousand times over in the splendid remains of a mighty past. His form stands out clearly among the hieroglyphics of the sacred writings, and thousands of years hence the porphyry will bear his image, so long confided to its care." What Dr. Brehm says about the Sacred Ibis not now occurring in Egypt is quite true, as it is only a rare and occasional straggler to that country, though it is plentiful in other parts of Africa.

THE FOURTH FAMILY OF THE HERODIONES.—THE FLAMINGOES (*Phœnicopteridæ*).

These curious birds are often placed with the *Anatidæ*, or Ducks, with which their internal anatomy allies them, but in their osteology they are intermediate between the *Anseres* and the Storks and Herons, to which they also show an approach in their extremely long legs. The neck of the Flamingo is very long, and the bill is quite peculiar.

About eight species of Flamingo are known to science, and they are found in most of the temperate and tropical portions of both the Old and New Worlds, but do not occur in the Australian region, nor in the northern parts of either hemisphere. One species (*P. andinus*) is only known to inhabit the Chilian Andes, and appears to be a mountain species. Many of the others have tolerably wide ranges, and all appear to frequent the same kind of haunts, affecting marshes and shallow lakes. The European Flamingo (*Phœnicopterus antiquorum*) is a migrant to Southern Europe, arriving as early as February, though the principal flights take place in April, May, and

June, and the females come before the males. The return migration occurs in the late autumn. As a rule they prefer brackish lagoons and salt-water lakes in the vicinity of the sea-coast, and seldom frequent fresh-water lakes. In deep water they swim, their toes being webbed like those of a duck, but ordinarily they wade out in the water to a suitable depth, and then bend down their long necks to rake the bottom for food. The upper mandible is plunged downwards into the mud, and the tongue is busily occupied during the progress of feeding rejecting what is not good for food, the refuse being drained through the sieve-like apparatus on the bird's bill. The breeding habits of the Flamingo are curious, and are described by Mr. Howard Saunders in his paper on the "Birds of Southern Spain" as follows:—"The Flamingo always makes its nest in the flattest part of the

FLAMINGO.

marsh, in places where there is from three to four inches of water. The nest, which rises to about half a yard above the surface of the water, is made of mud, like that of a Swallow. Its shape is almost cylindrical, but somewhat wider at the base. There is a slight concavity for the eggs, oval in shape, like that of the inside of a hat. When the bird is sitting she has her legs stretched out behind, hanging in the air (that is to say, unsupported) like the arms of a man when he puts them behind his back and throws his shoulders forward. The complement of eggs is five, and the birds, when once frightened from their nests, do not return. To raise itself, the bird 'scrambles' with its feet on the side of the nest till it lifts its body clear, and then takes wing."

THE EIGHTH ORDER OF BIRDS.—THE GEESE AND WILD FOWL (*Anseres*).

The present order is a large one, and though nominally called the Geese, from the fact of the genus *Anser* giving its name to the order, it contains by far the larger number of web footed birds, all the Ducks, Geese, and Swans being included within its limits. The order *Anseres* contains two families, the *Palamedeidæ*, or Screamers, and the *Anatidæ*, or Ducks.

THE FIRST FAMILY OF THE ANSERES.—THE SCREAMERS (*Palamedeidæ*).

These singular birds are natives of South America, and are only three in number, the Horned Screamer (*Palamedea cornuta*), from Guiana; the Crested Screamer (*Chauna chavaria*), from Southern Brazil and Paraguay; and the Derbian Screamer (*Chauna derbiana*), from Colombia. They have a horn on the forehead, and very powerful spurs on the wings, and these are of great assistance to the birds in defending themselves and their young from the attacks of birds of prey. As a rule, however, their habits are gentle and shy, but they fly with great power, owing to their broad and powerful wings. The Crested Screamer is said to be domesticated by the natives, and goes about with the poultry, being, from its large bulk and formidable wings, a very able defender of the latter birds.

THE SECOND FAMILY OF THE ANSERES.—THE WILD FOWL (*Anatidæ*).

In this group, containing the Ducks, Geese, and Swans, the feet are very short, and the tarsus is always strongly reticulated in front; the bill is almost straight or, at the most, gently curved, and the tip is convex and rounded at the extremity, in many of the species forming a conspicuous knob, like a finger-nail. The hind-toe, which is present in all, is small, and does not touch the ground. The sides of the face also generally present an angular appearance, having a triangular patch of feathers placed between two bare spaces. The family may be further divided into groups, the Geese, the Swans, the true Ducks, the Scoters and Eider-Ducks, the Mergansers, and the Diving Ducks.

BLACK SWAN.

In the first group, the GEESE, the hind-toe is simple, and the bill is deep, with a very conspicuous "nail" at the end. Many of the Geese are very remarkable in form, especially the Dwarf Geese (*Nettapus*), which do not exceed a foot in length, and are found in Africa, India, and Australia. Another curious bird is the Cereopsis Goose (*Cereopsis novæ hollandiæ*) of Australia, which used to be plentiful in the islands of Bass's Strait, but is fast becoming rarer, owing to its unwillingness to fly. The earlier voyagers recount their having killed numbers of these birds with sticks, and the flight of the Cereopsis Goose is described as being remarkably heavy, and performed with difficulty. Its nearest ally, the extinct Goose of New Zealand (*Cnemiornis*), appears to have been altogether incapable of flight. In captivity the disposition of the male bird is most pugnacious, and it is

SUMMER OR WOOD DUCK.

necessary to keep them apart from other birds, as they will attack and kill any bird within their reach, even species as large as Cranes. In their fighting propensities they resemble the Spur-winged Geese (*Plectropterus*) of Africa, which have a warty excrescence on the face when adult, and powerful spurs on the wings. The majority of the Geese, however, remain in the genera *Anser* and *Brenthus*. Of the former genus several species visit England, passing to the extreme north to breed. From the Grey or Wild Goose (*Anser anser*, Linnæus) the Domestic Goose is supposed to be descended. The Sea Geese (*Brenthus*) are smaller birds and of more compact build, as well as rather more variegated plumage, the Red-breasted Goose (*B. ruficollis*) being a really handsome bird. The Sea Geese resort to the most northern regions to breed, and the Brent Goose (*Brenthus bernicla*) was found by Captain Feilden nesting on the shores of the Polar basin. It is also the most common species in England in winter, occurring in large numbers on some of the tidal harbours and estuaries. Several species of Brent Geese occur in South America, and are very handsome birds, the males and females differing conspicuously in plumage.

In the second group of the Wild-fowl are the SWANS (*Cygnus*), remarkable for their extremely long necks, which exceed the length of the whole body. Their short legs, which are placed rather far backwards, render the Swan's movements on land awkward and ungainly, but in the water their motions are graceful in the extreme. Their food consists of vegetable substances and weed, which they search for under the water, their long necks enabling them to dip down below the surface and to reach their food at considerable depths. In most of the Swans the windpipe enters the bony portion of the sternum, and performs several evolutions before passing to the thorax. The Whooper, or Wild Swan, visits England in the winter, when it is frequently killed both on the sea-coast and inland. On the tidal harbours of the south coast it consorts with Brent Geese and Ducks, and several are often obtained by a successful sportsman with a punt gun. The Swans breed in high latitudes, but the tame species which frequents the rivers and lakes breeds on the eyots and shores, and makes a very large nest on the land, in which sometimes as many as six eggs are deposited. The latter are of large size and of a greenish colour. When the young are hatched they are covered with a greyish down, and both parents display great affection for their offspring, the males being particularly pugnacious, and driving off any intruder who may approach their domain. They fight with their wings, with which they deal tremendous blows, often breaking the wing of their adversary. In Australia a peculiar species occurs, the Black Swan (*Cygnus atratus*), but perhaps the handsomest of the genus is the Black-necked Swan (*Cygnus nigricollis*) of Antarctic America. Both these southern species show a marked contrast to the northern Swans, which are white when adult.

In the next group occur the true DUCKS, of which the Common Wild Duck (*Anas boscas*) is the type. This well-known species is one of the most widely distributed of this wide-ranging family, for it occurs not only all over the northern portion of the Old World, extending to China and Japan, but it is also met with in North America, as far south as Mexico. The Wild Duck breeds in many parts of the United Kingdom, and where not disturbed does not betray any great fear of man. The nest is placed on the ground, often at some distance from the water, and in one instance the writer remembers having come across a Duck sitting on nine eggs at least half a mile from the lake where numbers of others were breeding. It is strange that the sitting bird should expose her young brood, even if they should be safely hatched, to the risk of capture by a fox or other wild animal on their way to the water. The nest in question was placed in a small wooded dell, and was overhung by a bush, which would have effectually concealed it had not the old bird betrayed its presence by flying off. The Mallard is a much more handsome bird than the Duck, and both sexes closely resemble the common Duck of the farmyard. In summer, however, the male bird loses its rich plumage, and dons a dress like the female, only resuming its beautiful colours again in August. A good decoy, where many Wild Ducks are to be seen, is often a pretty sight, the birds swimming about in pairs, when the fine plumage of the male contrasts with the more sober colour of his mate. At times they may be seen tail uppermost, searching below the surface for their food, which consists of worms, grass-seeds and roots, mollusca, insects, small reptiles, and little fish. On being approached they fly off with a sonorous quack, that of the female being the louder. During the breeding season the males consort much together, and on taking flight mount high in the air and circle round some distance before again settling down. The female evinces great attachment to the young, and may often be seen attended by her little brood, who on the approach of danger manage to conceal themselves most adroitly, while the mother will feign lameness, or pretend to be wounded, in order to draw away the intruder from the whereabouts of her brood. In the same group as the Wild Duck are also contained the Sheldrakes, Shovellers, and the Teal, besides several other genera.

In the fourth group of the Ducks are the SCOTERS (*Œdemia*) and EIDERS (*Somateria*), etc., which have the hind toe lobed, and the same peculiarity of the hind toe exists also in the next group, the MERGANSERS. In the latter birds the bill is very long, and more slender than in the other groups. They are mostly birds of northern regions, occurring in both the Old World and the New; and two species, the Goosander (*Mergus castor*) and the Red-breasted Merganser (*Mergus serrator*), breed in the north of Scotland, though they occur more frequently in winter, at which season they are shot, not only on the harbours of the coast, but also on inland lakes and rivers. Both species are migratory, visiting India in the winter, but in the Southern Ocean there is one species (*Mergus australis*) which has as yet only been met with in the Auckland Islands. The beautiful Smew (*Mergulus*

albellus) is also one of the Merganser group, and has much the same habits and range as the before-mentioned species, ranging, like them, into India in winter, and passing the summer in the northern parts of the Old and the New Worlds. The genus *Merganetta* also belongs to the group, and contains three species of beautiful coloration, confined to the Andes of Chili and Peru and the high ranges of Ecuador.

The last group of the Wild-fowl contains the STIFF-TAILED DUCKS, which are recognisable by their extremely rigid tail-feathers, which are narrow and pointed, and are not covered at the base by the upper tail-coverts. The tail-feathers in some species attain to the number of twenty-four. The hind toe is lobed. As a rule these Ducks are not so much inhabitants of the northern portions of the globe as were the preceding members of the sub-family, but are found in the more temperate and warmer climates, especially in the southern regions of the world; they are also more strictly inhabitants of lakes. One species, the White-headed Duck (*Erismatura leucocephala*), occurs in South-Eastern Europe and Northern Africa, and is stated to be an expert diver, seldom taking to its wings, and when flying appearing more like a Diver than a Duck, the wings producing a very audible whirring sound as they progress through the air. Perhaps the most remarkable of all the Diving Ducks is the great *Biziura lobata* of Australia, the male of which has a large lobe of skin hanging down under the chin, the female being of only half the bulk of the male.

THE NINTH ORDER OF BIRDS.—THE PELICANS (STEGANOPODES).

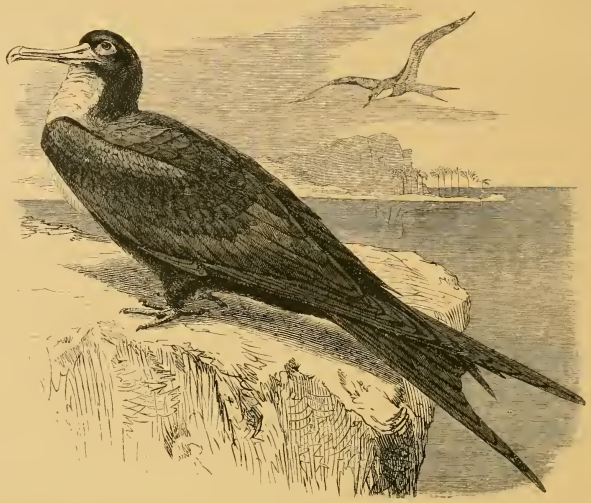
Under the heading of the Pelicans not only the latter birds are included, but also all the Cormorants, Frigate Birds, and Tropic Birds. They form three families, and are all of them distinctly recognisable by the form of the feet, all the toes being united by a web, which joins the hind toe as well as the three front ones. In this respect they differ from the Ducks, and Gulls, and other swimming birds.

THE FIRST FAMILY OF THE STEGANOPODES.—THE FRIGATE BIRDS (*Fregatidæ*).

The Frigate Birds, or Man-of-War Birds, as they are also called, are inhabitants of the tropical ocean, ranging far south, but not occurring in northern latitudes. The tail is very long and forked, the bill powerful and hooked, so that by some ornithologists they have been considered to be not distantly related to the birds of prey. Their flight is most airy and buoyant, and the rapidity with which they fly is extraordinary. They are robbers in every sense of the word, following up the more pacific Terns and Gannets, and forcing them to disgorge the fish they have captured with so much patience, pursuing them in mid-air, and dexterously catching the fish as the frightened quarry lets it fall. Audubon states that he believes the Frigate Bird to be possessed of the most powerful flight of any known bird, and he relates having seen one of them pursue a Cayenne Tern and force the latter to let go of a fish it had captured. The latter was about eight inches in length, and had been seized by the robber in a manner inconvenient to swallow. It therefore mounted about a hundred yards, let the fish fall and caught it again, but then not satisfactorily, and it again dropped it, reclaiming it, however, before it had fallen many yards, when he at last managed to catch it conveniently, head foremost, and gulped it down. The Frigate Birds apparently always build in rookeries on trees, and Mr. G. Cavendish Taylor has published an account of his visit to one of these breeding-places off the coast of Honduras:—

"On the 1st of January, 1858, we went off in a boat, with four rowers, to visit an island some four or five miles from Tigré Island, in the Bay of Fonseca, on the Pacific coast of Honduras. It is called Bird Island, and is not more than an acre in extent, and of an oblong shape. At one end the beach is sandy, and at low water one can walk across to another island close adjoining. At the other end the shore is rocky, and it is much the same at the sides, the beach being strewn with large volcanic stones. The surface of the island is some thirty or forty feet above the sea level. It is covered with long grass, and there are also a few trees and low shrubs—mangroves (*Rhizophora mangle*, Linnæus)—growing in places, especially about high-water mark. At a distance the most conspicuous object was a numerous flight of Frigate Birds soaring over the island. As we approached, large white patches, caused by the droppings of the birds, became visible. We landed on the flat sandy beach, and in a few minutes I had shot a pair of Tiger-Bitterns (*Tigrisoma tigrinum*), which allowed me to approach without any difficulty. Besides these and the Frigate Birds we saw no birds on the island, except a few Pelicans.

some large Accipitres, and a single Booby (*Sula fusca*), which had its nest on a low tree in company with the Frigate Birds. The whole island was appropriated by the latter. Nearly every tree and bush, both high and low, was covered with birds and their nests. The latter were mostly composed of a few sticks laid crossways, hardly as much in quantity as in the nest of the Ring Dove (*Columba palumbus*). Each nest contained a single egg, about the size of a hen's egg, and of a chalky whiteness. We brought away nearly a hundred of them. Some were quite fresh, and others had been sat upon some days. Although the nests were upon low bushes, still they were placed just too high for one to reach the eggs without climbing. Many of the nests were on the mangrove bushes which were growing just above high-water mark, so that we could see into them when standing on the bank of the island,



FRIGATE BIRD.

which was at a higher level. Some of the birds were sitting on their nests, and others were perched upon the branches. By firing into the mass I might have killed a dozen at a shot, but shooting would have been an absurdity, for I could have obtained any number with a stick. The difficulty was to get them off their nests. Shouting had little or no effect; and even the report of a gun would only raise a few, who would frequently settle again on the bushes. I threw some stones among them, without producing much result, and even tried to poke them off their nests with my gun; but they merely snapped their beaks at me in retaliation. All this time there were thousands of other birds soaring in the air a little way over our heads. I observed that the Frigate Birds were of three different plumages. As there were birds of all three sorts sitting together, and with their nests in the same bushes, I concluded that they were of one and the same species—males, females, and immature birds. Some have the head and neck white, the beak white, the feet and legs bluish-white, the belly white, and the wing-coverts greyish-brown. Others have the legs and feet black, and are black all over, with a greenish metallic tinge on the black. These have a bright scarlet pouch, which they inflate to the size of an Ostrich's egg

while on the wing. The boatmen informed me that these were the male birds. Others, probably immature birds, had the head black, the throat white, and the legs and feet pink. All had long black forked tails. I obtained a specimen of each, but did not preserve them, as I had much to do; and besides, they are stinking birds to handle, as bad as, or worse than, the Turkey-Buzzard (*Cathartes*). The Pelicans have also a breeding-place in Fonseca Bay, but it is in an island at some distance from the one in possession of the Frigate Birds."

In the Ellice Islands, the Rev. S. G. Whitmee states that the birds are domesticated by the natives, and when he was in those islands in 1870 he saw scores of them about the villages, sitting on long perches erected for them near the beach. The natives procure the young birds and tie them by the leg and feed them till they are tame. Afterwards they let them loose, and they go out to sea to get their food, and return to their perches in the villages. The same gentleman also informed the writer that a post had been established between some of the islands by the missionaries, much after the fashion of Carrier Pigeons in England, and Mr. Whitmee had himself seen more than one letter arrive in a quill attached to the bird.

THE SECOND FAMILY OF THE STEGANOPODES.—THE TROPIC BIRDS (*Phaethontidæ*).

These birds, more familiarly known to mariners as "Bo'suns," are inhabitants of the centre of the ocean between the tropics, and are generally observed following in the wake of vessels. From their white plumage they have much the aspect of Sea Swallows, which they also resemble in their flight. They may, however, be distinguished by the two long central tail-feathers, which in one of the three species known are red, in the other two white. Mr. Hume describes the Tropic Birds as not uncommon in the northern portion of the Indian Ocean. They flew about the ship much like

TROPIC BIRD.

Terns, with their longish bills pointed downwards after the manner of the Caspian Tern. They seemed totally fearless, and were in fact attracted to the vessel by guns which were fired at other birds; but they did not come very close, not nearer than seventy or eighty yards as a rule, but they flew round and round at this distance for some time. They were in small parties of ten or twenty in number. Mr. Penrose, writing on birds from the island of Ascension, states that all these species of Tropic Birds, and some other sea-birds, such as the smaller Skuas, are familiarly called Boatswain Birds by the sailors, owing to the resemblance of the projecting tail-feathers to a marling-spike. The Tropic Birds feed principally on crabs, and they breed on a little island lying off the eastern coast of Ascension, named "Boatswain Bird Island," nesting in holes in its sides, and laying only one egg. Curiously enough, the male and female are found sitting in their holes side by side, with their heads inwards; and as soon as one has been drawn out it begins to use its beak to considerable purpose. Two species of *Phaëthon* nest on this small island.

THE THIRD FAMILY OF THE STEGANOPODES.—THE PELICANS (*Pelecanidæ*).

Besides the true Pelicans the present family contains the Gannets (*Sula*), the Darters (*Plotus*), and the Cormorants (*Phalacrocoracæ*). The Common Gannet (*Sula bassana*) gets its specific name from its historical association with the Bass Rock, which is one of its well-known breeding-places. The number of birds which frequent that locality is prodigious, and Mr. Seebohm tells us that when he visited the Rock he found every available ledge on the steep side occupied with a nest. In fact, it overflows with them, and on the top a number of nests are placed for which there is literally no room on the ledges of the cliffs. Among these nests a person may walk, and in many cases push the birds off them. The nest, according to Mr. Seebohm, is made of sea-weed, and is very similar to that of the Cormorant. He never saw more than one egg, which resembled that of the last-named bird, but was perhaps twice the bulk. Looking down the cliff on to the myriads of birds flying in every direction reminds the observer at once of a snow-storm. The young are almost black when first hatched, but are afterwards covered with a white down. For the first year they are of a dark grey colour, afterwards mottled, but it is not until the fifth year that they attain their white plumage and commence to breed. They come to the Bass Rock in the early part of March, remaining till October, and sometimes till November. In the winter only stray birds are seen, and these are very wild. When the Gannet leaves the shores of England in the winter it is seen in large quantities in the Strait of Gibraltar. Colonel Irby states that he has seen them close to the Rock of Gibraltar in large numbers, where, according to the wind, they might be noticed fishing on the leeward side of the rock, particularly close to Gibraltar, and many a time he has watched them darting down from a considerable height on their prey, often disappearing quite under the water. On the wing, to an experienced observer, they look like a large Gull. The earliest dates on which he observed this species near Gibraltar were on the 11th of November, 1870, and the 12th of October, 1871, while in the spring he saw them as late as the 28th of March.

In the typical Gannets, such as the European bird just noticed, the throat is feathered, with a naked line in the middle, but there are several small species frequenting the tropical and southern oceans which have the throat bare, as well as the whole of the face, and belong to the sub-genus *Dysporus*. They also frequent islands, and an interesting account is given by Mr. Osbert Salvin in his paper on the Sea-birds of British Honduras, of a visit paid by him in 1862 to the cays off the last-named coast:—

"The northern end of Half-moon Cay, which is long, and shaped as its name implies, is occupied by the pilots, who have their houses scattered about under a grove of cocoa-nuts. There are but few mangroves, but the southern portion, as well as nearly the whole windward side, is covered by low 'bush.' A large colony of Boobies (*Sula piscator*) hold entire possession of this portion of the island, every tree having four or five nests in it. By the time we had made acquaintance with some of the pilots, and had taken a 'long drink' of cocoa-nut milk (a luxury after the stale water we had had to put up with on board the schooner), it was mid-day, yet we made our way through the trees to search for Boobies' eggs. The sky was clear and the heat intense, the sea-breeze not yet blowing with any force, and the foliage not being thick enough to afford much

shelter from the scorching rays of the sun. The Boobies, too, seemed affected by the heat, and sat panting with open beaks; some, still more overcome, were resting against a branch, with their heads hanging down and eyes shut. At first I thought these were dead, but on stirring them up, I succeeded in making them open their eyes. I could not, however, prevail upon them to get up; they only screwed their heads about with a sort of expression that seemed to ask me what I meant. Over many of the nests one of the old birds sat, and in the same trees the fully-fledged young still remained.

DARTER, OR SNAKE-NECK.

The young were of every age, their plumage including every stage, from the white down of the newly-hatched chick to the grey dress of the full-grown. In some few, still older, the white dress of the adult was beginning to show itself. The name Booby is most appropriate: I never saw a bird with less idea of getting out of one's way, or caring less for what one did. Walking about under the trees was nothing; they hardly condescended to look down; nor when we stirred them up while taking a 'siesta,' pulled their tails, poked them off their nests, and fought with them for their eggs, and bullied them in every way, did we succeed in getting up any sort of excitement in the colony. They took everything with the greatest indifference, with a complaisant, grave expression that was laughable to watch. And yet a Booby is no fool at fishing. Rare sport they must have of it, flying at the pace

they do, and taking such headers. It was too hot to climb to every nest within reach; and after trying a few, we found that there was always a chance of an egg in a nest upon which, and not near which, an old bird sat. Even in this way, after a long search, we only secured four rotten eggs. A few Man-of-War Birds breed in the same trees, nearly all of which had eggs. This Booby makes a nest very like that of a Man-of-War Bird, *i.e.*, of twigs rather untidily laid together in a convenient

CORMORANT.

fork in the top of a tree. I could not easily calculate the number of birds in this colony, but there were certainly several thousands."

The Darters (*Plotus*) are only four in number, and are inhabitants of the tropical and southern portions of both hemispheres, never occurring in the northern parts. One species inhabits South America, another Africa, a third India and the Malay countries, and a fourth Australia. They are also called Snake-necks, from the habit they have of swimming with the body submerged and only the neck exposed above the water, so that they really look not unlike a snake coming along. They are on this account not very easy to shoot, as their long thin necks offer a very indifferent target. They inhabit fresh water, and are not shy in districts where they have been unmolested.

The Cormorants (*Phalacrocorax*) are a much larger group than the Snake-necks, and are found all over the world, some of them being very large, while others are quite small and of elegant form. Many of the Cormorants are ornamented with a somewhat metallic plumage,

whilst not a few in the breeding season have some distinctive addition to their dress, either in the shape of a fine crest or wattles on the face. The British species, for instance (*P. carbo*), has, when in full plumage, not only a crest, but exhibits a white patch on the lower flanks, and some white filamentous plumes on the neck. Mr. Seebohm allows us to make the following extract from his interesting journal of a visit to the Fern Islands, off Northumberland. He writes:—"The next island which we visited was that in which the Cormorants had established their colony. It consisted of an irregular reef of rocks rising on one side of the island somewhat abruptly out of the sea, to the height of ten or twenty feet, and sloping away into the sea on the other side with a rocky, shingly shore. As we neared the island we could see the weird-looking birds standing, some on the rock and some on the edge of their nests, stretching out their long snake-like necks, and evidently becoming alarmed at the approach of our boat. Before we got near enough to land they took wing, and retired to a distant part of the island, one old female, apparently the grandmother of them all, being the last to leave. The whole of the surface of the rocks was covered with the dung of the birds, and the smell was, of course, very strong. We counted upwards of seventy nests, large structures, being heaps of sea-weed from one to two feet high, and generally lined with the fresh thick green leaves of the maritime plants growing on the islands—sea-parsley, &c. The natural colour of the Cormorant's egg seems to be a bluish-green, like the usual variety of the common domestic Duck, but over this is a thick white irregular coating of lime, which is frequently in such abundant quantity as to stand in lumps on the surface, seldom allowing much of the original colour to be visible. No doubt this superabundance of lime is produced by the bones of the fish of which this bird is said to eat prodigious quantities, and perhaps also from shell-fish." In many of the islands off the coast of northern Europe, and on the Danubian islands, vast colonies of Cormorants breed together in company with Wading-birds, Herons, &c., and the same occurs with the American species. Mr. Salvin gives a very similar description of the nesting of the Florida Shag (*Phalacrocorax floridanus*) in the cays of Honduras to that given by Mr. Seebohm above. Landbeck gives an account of the Cormorants in one of the Danubian islands, when he describes the breeding of the Herons already quoted (p. 184):—"After we had procured such specimens as we wanted of the three species of Herons and had, on passing a swamp, watched the manœuvres of one or two Purple Herons, we determined to visit the Cormorants, which were breeding near by, in single pairs and also in large colonies, in company with Herons. The same sickening scene which we had observed at the first heronry was about to be repeated here: dung, broken egg-shells, putrid fish and birds, gave off the same noisome stench as in the first place. The Cormorants, young and old, sitting complaisantly on their nests, bestowed wondering glances on the uninvited guests from their beautiful sea-green eyes, while the parent birds greeted us with a deep bass note, not unlike an outburst of laughter, which may in some way be compared to the sound, *Goc-goc-gog-gog-gog*, and their offspring set up a curious whistling sound, resembling *Haidioh, haidioh*, which sound we thought rather pleasant than otherwise. As soon, however, as we disturbed this peaceful scene by a shot, the Cormorants darted from their nests like snakes, with the speed of an arrow from a bow, over the trees to the other side, but did not return as soon as the Herons. After we had hidden ourselves amongst the bushes they came back, flying at a great height round and round, examining to see if the coast was clear; and at last, as soon as they seemed satisfied that all was safe, they darted on to their nests with the same celerity as they had left them, squatting close, so as to keep themselves out of sight; their caution, however, proved unavailing, and several fell to our guns. The wounded showed a courage and determination which quite surprised us: the winged birds turned at bay with great ferocity, dealing our dog such a hail of blows with their beaks as to drive him howling away. An old bird which I had mortally wounded gave me a blow through my trousers which instantly drew blood, while my brother was struck by another on the forehead, between the eyes, and narrowly escaped being blinded. The nests of these birds were larger and better built than those of the Herons, offering no small resistance to our shot."

In the Pelicans (*Pelecanus*) the principal feature is the long furrowed bill and the enormous pouch to the lower jaw, which is drawn up when the bird is at rest, but is capable of extension to an immoderate extent, and is used by the bird as a bag to hold the fish which he catches in large quantities. The number of known species of Pelican is under a dozen, and they are not found in northern climates at all. On the Nile the Common Pelican (*Pelecanus onocrotalus*) is very common, and is

PELICANS.

(*From the Living Specimens in the Zoological Gardens, London.*)

seen in vast flocks. Brehm gives an excellent account of their habits from his own observations in Egypt and the Nile Valley. He states that in no other part of Africa did he see such vast numbers of Pelicans collected together as on the Lake of Menzaleh, where the flocks of these birds covered the water to the extent of a square mile or more, looking, at a distance, like gigantic water-lilies. If any one shoots at them they rise *en masse*, with a rushing sound, not unlike the rolling of drums, which may be heard a mile off. The same observer relates that they lie on the water as if they were made of cork, and it is only in shallow water, to the bottom of which they can reach with their long neck and hooked bill, that they usually fish for food. They hunt in company, and on large lakes or on the sea-shore they form a semicircle, gradually paddling inwards and narrowing the diameter, so as to enclose the fish, which fall victims to the rapacity of these powerful birds. On narrow rivers or canals they form two lines, which face each other and gradually meet, so as to drive the fish between them. They will, however, swallow young birds and ducklings, though fish is their general food. The daily life of a Pelican, writes Dr. Brehm, "is conducted in a very regular manner: the early hours of morning are employed in catching food, and they may then be seen hastening from all quarters to the fishing-ground, in small or large parties, the former flying in single file, the latter in the well-known V-shape adopted by many birds of passage. Some parties may soon be seen returning from the water, satisfied with their meal, while others are making their way towards the shallow bay from which breakfast has to be procured. Towards 10 o'clock a.m. they begin to congregate upon their favourite sand-bank, or an inland group of trees, and here they repose after their toil, some lazily digesting their food, and others more actively employed in oiling and preening their feathers, a proceeding in which they are occupied for a considerable length of time, their long, unmanageable bill being but little adapted to the work. When this is accomplished, they take a kind of siesta, some perched on trees, others on the ground, the former generally sitting bolt upright upon the branches, with their necks resting on their breasts, while the latter generally lie flat on their bellies, and doze away the noontide hours. Between three and four o'clock the whole assembly begins to wake up and prepare for another fishing excursion, in which they are engaged till sunset, after which they at once set off to their sleeping places, situated on a lonely sand-bank, or some island covered with trees, upon the branches of which they pass the night." Other naturalists have commented on the peculiarity of the Pelican perching on trees, the most unlikely resting-place for a bird of such heavy bulk. "It was a bold Pelican," observes Mr. Osbert Salvin, "that first perched upon a tree; a bird less adapted to such a resting-place could hardly be imagined. Yet there they sit on the mangrove boughs for hours, preening their feathers with their long, hooked bills, an amusement they seem to take special delight in, all the time keeping their balance with ease, even when a strong wind tries the security of their footing."

THE TENTH ORDER OF BIRDS.—THE SEA BIRDS (GAVIÆ).

These elegant and beautifully-plumaged birds may be divided into two large families, the Gulls and the Petrels, all of them being long-winged birds (Longipennes of Cuvier), and consequently of very powerful flight. In the Gulls the hind toe is small, elevated above the level of the ground, and not united by a web to the other toes. The nostrils are placed laterally in the bill, and are rather low down in the upper mandible, as well as longitudinal. The general colour of the plumage is grey and white, the latter predominating. There are three sub-families of the Gulls, the Scissor-bills, the Terns, and the true Gulls.

THE FIRST SUB-FAMILY OF THE LARIDÆ, OR GULLS.—THE SCISSOR-BILLS, OR SKIMMERS (*Rhynchopinæ*).

In these peculiar birds the bill is the characteristic feature, being long and thin, the mandibles very narrow and compressed, the lower one longer than the upper one. In other respects they much resemble Terns, the wing being very long and sharply pointed, the tail forked, and the feet small. Only three species are known, one being found in America, another in India, and a third on the Nile and the Red Sea. Dr. Jerdon gives the following account* of the Indian Scissor-bill (*Rhynchops albicollis*):—

"This remarkable bird is found throughout India, frequenting rivers, especially the larger ones.

* "Birds of India," Vol. III., p. 947.

It associates in flocks of from twenty to fifty or more, and skims up and down the river with a peculiar flight, keeping close to the water, and now and then dipping its bill into the stream. It is asserted that it picks up small fish and crustacea, and it is quite possible that it does so occasionally, but I have examined several, and never found any remains of those animals in their stomachs. I have generally discovered merely a little oily fluid, and I confess that I am ignorant of what it actually lives on. Some travellers have asserted that the African species feed on the ground, searching the soft mud with their beaks, but I have never seen the Indian birds so engaged, and doubt their doing so. At one time I was inclined to think that these birds perhaps fed at night, and had such a rapid digestion that no remains of their food were to be seen during the day, but on one occasion I shot several, in company with Mr. W. T. Blanford, on the Irawaddy, rather early one morning, and we found nothing but the usual oily fluid, and that in very small quantity. The Skimmer breeds in April and May on sandy churrs, laying four, occasionally five, eggs of a pale stone-yellow colour with blotches of grey and brown, quite Tern-like. The young when hatched are stated by Burgess to be clad in a whity-brown down, with dark spots. Mr. Brooks writes me that he found the young Skimmers hatched by the 15th of April, at Mirzapore, and that 'it was amusing to see an army of some hundreds of these little fellows (tortoiseshell-looking things) running steadily a couple of hundred yards before us. They run well, and when we reached the end of the sand-bank they attempted to swim off, while many squatted down. They did not make much way swimming, and sank very deep in the water.'"

THE SECOND SUB-FAMILY OF THE LARIDÆ—THE TERNS, OR SEA-SWALLOWS (*Sterninæ*).

These elegant birds have the plumage of miniature Gulls in a great degree, but are of a much more slender build, with very long and pointed wings and tail, and very short legs. Their flight is extremely graceful, and nothing can be more interesting than to watch a flock of Sea-Swallows engaged in hunting for their prey. Flitting along with a fairy-like flight, they may be seen dancing over the water, every now and then dipping down on the surface with a gentle splash after something which their sharp eyes have detected. They are not, as a rule, met with far from land, and sometimes large flocks may be seen beating about off the coast, and hunting in company. After severe weather they may be found on inland lakes or rivers, and several instances of the Black Tern (*Sterna fissipes*) occurring on the Thames at least sixty miles from the sea, have come under the writer's notice.

Several species occur on the coast of Great Britain, and Mr. Seebohm's journal of his trip to the Fern Islands off the Northumberland coast contains many very valuable notes on the Sea-Swallows:—"By far the most interesting and beautiful birds inhabiting these islands are the Terns, of which there are three, and perhaps four, well-marked species breeding in the locality. The most important of these is the Sandwich Tern. On the short grass between the masses of bladder campion that grew in the wide Opens almost to the spring high-water tide-mark I found three and four eggs of this bird. On one side of the wide Opens is a very much smaller island, almost bare of vegetation, and connected with the larger island by a long shingly beach, which is entirely covered at high water. It being about low water I trudged patiently and laboriously over the loose stones until I reached the small island, which I found to be a perfect little El Dorado. On a gently sloping sandbank leading up to the nucleus of the island, or the island proper, which was merely a mass of shelving rocks perhaps thirty feet across, there was a colony of Sandwich Terns' nests. These nests, if such they could be called, were slight hollows in the base sand, about the size and depression, say, of a cheese-plate. The nests and their contents were so difficult to distinguish from the sandbank that my first discovery of the colony was to find that I had 'put my foot in it,' and broken a Tern's egg. In the thick of them there must have been an average of a nest for nearly every square yard. On this little island in less than a quarter of an hour I found an Eider Duck's nest with eggs, several Lesser Black-backed Gulls' nests with eggs, besides taking four Ringed Plover's eggs, seven Oyster-catcher's eggs, about a dozen eggs of the Common and Arctic Terns, and more than a hundred eggs of the Sandwich Tern, and I suppose I might have taken at least a hundred eggs of the latter bird if I had been so disposed. All the eggs of the Sandwich Tern which I brought away were in splendid condition, most of them apparently being just fresh laid. Some of the nests, or hollows in the sand, for they could scarcely be called nests, contained two eggs, a very few had three, but by far the largest number contained only

one egg. They varied considerably in colour, and some of the darker varieties approached those of the Oyster-catcher.

"On the same island, as well as on one or two of the others, was a colony of smaller Terns, which were flying about and making a great noise, as long as we were near their eggs. They make rather more of a nest than the Sandwich Tern, but it is nothing more than a slight depression in the sand or shingle, with an apology for a lining composed of dry stalks of the bladder campion. In some cases the eggs were laid on the ground without the slightest appearance of any nest, the eggs being generally two, rarely three. We were told that these colonies of smaller Terns were of three species, the Arctic, the Common, and the Roseate Tern, but the latter we were unable to make out. The majority were undoubtedly Arctic Terns, with the brilliant orange bill and light grey breast, but we could easily distinguish a considerable percentage of the Common Tern, with black-pointed bill and pure white breast. It was quite impossible to identify the eggs, as the nests were too near together, and the birds too shy. My drawer of these eggs contains eighty fine specimens, varying in colour from that of a Snipe to that of a Jackdaw. I suspect that the large wide eggs, with the small end pointed, are those of the Common Tern, and the small oval eggs are those of the Arctic Tern, but there are so many eggs intermediate in shape and size, that it is impossible to know where to draw the line. The Terns are very elegant birds upon the wing, their swallow-like shape, with their long wings and long forked tails, being extremely graceful, while their brilliant orange legs and bills are in exquisite harmony with the delicate dove-colour and white of the general plumage."

In some of the nesting-places in the Tropics, however, the Terns assemble in prodigious numbers, and on Ascension Island there are three of these "Wide-awake Fairs," as they are called. The late Commander Sperling has given an account of a visit to one of these fairs, the bird which is called on Ascension "Wide-awake" being the Sooty Tern (*Sterna fuliginosa*). "On the 8th of June, 1867," writes Sperling, "I was literally cast ashore on that island, for the periodical rollers were dashing against the coast, and my boat was upset in the surf; so giving myself a good shake, as the only available means of drying my clothes, I started for 'Wide-awake Fair,' the name which the blue-jackets who have visited the place have considered an appropriate one to designate the spot where the birds gather for nesting purposes. Leaving Comfortless Cove about the middle of the day, I walked over two dreary miles of cinders and ashes, uncheered by a symptom of vegetation, before I noticed flocks of Terns converging from various parts of the ocean to a spot apparently about a mile in front of me; but as yet I observed nothing of the 'fair.' At length, on turning slightly to the left, and surmounting a low ridge, the whole scene was disclosed. A gradual incline of a quarter of a mile terminated in a plain of ten or fifteen acres in extent, which was literally covered with the birds. The plain was surrounded by low mountains, except on the side on which we stood, and being entirely sheltered from the wind, its heat under the full blaze of a tropical sun was very oppressive. No description can give an adequate idea of the effect produced by the thousands upon thousands of these wild sea-birds floating and screaming over this arid cinder bed, the eggs and young scattered so thickly on the ground that in some instances it was impossible to avoid crushing them, and the bleached bones of dead birds were distributed in all directions. During our short walk down the incline, large flocks of parent birds hovered over our heads, and assailed us with plaintive cries, regardless of our sticks, with which we might have killed any number of them; but their beautifully pure dark and white plumage and graceful motions caused it to appear almost a sin to knock any of them down. On arriving within the precincts of the breeding-grounds their numbers increased; large flocks were arriving in endless succession from seaward; clouds of birds rose from the ground, and, joining those already attending us, their wheelings and gyrations almost made us giddy. I sat down on a lump of cinder, and the society, being at length convinced that my policy was not aggressive, went on with the ordinary routine of incubation. There were young of all sizes, from the little callow ones just hatched to the nearly fledged birds that fluttered and crawled like young pigeons. There were also lots of eggs exposed on the bare ground; but in most instances the old bird sat on its solitary treasure, hissing defiance as I approached, and fighting manfully if I attempted to remove it. The young are of a very light sooty colour both above and beneath, the ends of most of the feathers having a white spot the size of a pea, which gives them a speckled appearance. The whole of the 'fair,' both in smell and appearance, reminds one of the effect produced by a sudden entry into a large pigeon-house.

"In the interstices of the scoriæ and lava round this nursery lurk numbers of wild cats (not *Felis catus*, but the domestic breed run wild), and the bones of both old and young birds tell the tale of the ravages they commit."

Some of the most curious of the Terns are the White Noddies (*Gygis*) which inhabit the Southern Ocean, and lay but a single egg, which is placed, according to Mr. Howard Saunders, in the cavity of the branch of a tree, or in a fork of two branches, and on the points of the coral reefs: anywhere, in fact, where it will lie.

THE THIRD SUB-FAMILY OF THE LARIDÆ, OR GULLS.

THE TRUE GULLS (*Larinæ*).

In the Gulls, whose style of plumage is very similar in character to that of the foregoing birds, the wings are long and pointed, but not to so great an extent as in some of the Terns, and the bill is stouter and much more curved, there being a very prominent angle on the lower mandible, accompanied by a swelling on the upper mandible, which in most of the Gulls appears to divide the bill into very distinct halves, the division being generally accompanied on the lower mandible by a patch of brighter colour. The feet are also powerful, the tarsus longer, being equal to the middle toe and claw. Many of the Gulls, and particularly the Skuas (*Stercorarius*), are voracious robbers, while some of them, on the other hand, are pretty, graceful birds, of shy and timid dispositions. The Greater Black-backed Gull (*Larus marinus*) is one of the largest species known, and is peculiar to Europe and North-eastern America. It is a bird of predatory habits, doing great damage to the peaceful Eider Ducks and other wild-fowl, whom it harries relentlessly, and destroys numbers of their eggs and young. Dr. Sundström states that on the Island of Åland, off the Swedish coast, where this Gull is common, it is justly looked on as a pest, and is destroyed whenever it can be approached, which is not often, as it is very wary when it finds itself followed. It daily devours large numbers of fish, and destroys the eggs of the Eider and other Wild Ducks. He has seen it swallow small Eider Ducks, and kill and eat larger ones, and on Åland he saw one of these Gulls pursue an almost full-grown young Red-breasted Merganser (*Mergus serrator*), and force it to dive again and again, until it was tired out, when it fell a prey to its pursuer. Any dead birds that are floating on water or are on the ground are soon picked up by this Gull, and Dr. Sundström considers that it should be kept down in numbers as much as possible, as it is a very destructive bird, especially to useful birds like the Eider and other species of Water-fowl. The Lesser Black-backed Gull (*Larus fuscus*) is a miniature of the Greater species, and is distinguished by its smaller size and by its different note, as well as by its more active and lighter build. It is not quite so voracious a devourer of young birds as its larger ally, but destroys an immense number of eggs, and on the Fern Islands Mr. Edward Hargitt tells us that when the boat landed on the island where the Cormorants bred, they had to scramble up the rocks with the utmost speed to reach the nests of the latter birds before the Gulls swooped down upon the undefended eggs. On the Fern Islands, writes Mr. Seebohm, in his journal, the Lesser Black-backed Gull "is by far the most numerous bird. It is scarcely correct to say that there are many colonies of them on the islands, as the whole group may be considered to be a huge colony of these birds. It is a wonderful sight on nearing an island to see it sprinkled all over with these large birds, every one standing with his back to the wind, like an innumerable army of white weather-cocks, and still more wonderful when you land, and see them flying about in every direction, around and above you, like a living snow-storm, and a noisy one too. A very small percentage of these birds are Herring Gulls (*Larus argentatus*), and the latter may be readily distinguished by the decidedly lighter colour of the back and wings. The Lesser Black-backed Gull makes a nest, which is a large slatternly structure of dry grass and weeds, with, now and then, a lot of sea-weed, just the sort of nest that the agricultural native would be likely to make if he had imported a colony of cocks and hens from the mainland in the hope of breakfasting next morning on fried eggs and bacon. Wherever there was a suitable niche amongst the rocks these nests were placed without the slightest attempt at concealment. The number of eggs laid by these Gulls and sent annually to shore for culinary purposes must be prodigious. The Herring Gulls (*L. argentatus*) nest indiscriminately amongst their more numerous relations, and, in the few cases where we were able to mark the bird, we could discover no difference in the eggs, except that those of the Herring

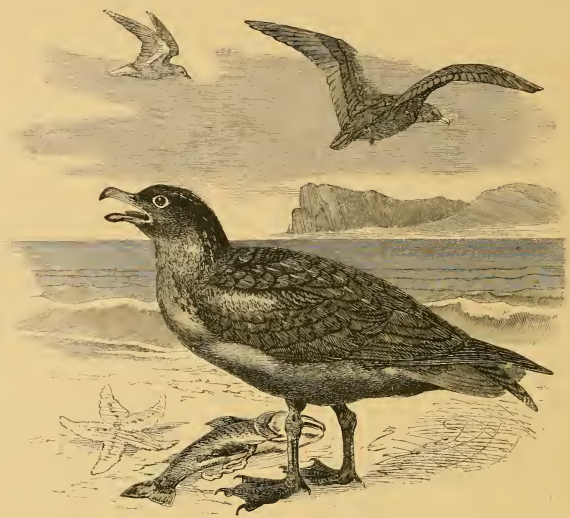
Gull appeared to be on an average slightly larger. The last-named species is found all over Europe and in North-eastern America, and from its lighter colour is often called the Silvery Gull. Macgillivray gives a good account of its habits, and writes as follows:—'On extensive beaches, and especially on such as run out into an angle or point, multitudes may be seen reposing, often intermingled with Common Gulls (*Larus canus*), and sometimes with individuals of the two Black-backed species. The flight of this Gull is strong and buoyant, direct and unwavering when the bird is proceeding towards a distant place, and then usually elevated, but on ordinary occasions somewhat devious, although from its size this species is not capable of turning and winding so dexterously as the smaller kinds. When engaged with a shoal of fry the Herring Gulls hover over the water, now ascending to the height of about twenty feet, then skimming close over the surface; and on observing an object, stretching upward and vibrating their wings, and letting down their feet so as to touch and sometimes pat the water, they pick it up without alighting. Sometimes they plunge partly into the water, and occasionally pick up their prey while swimming. All this while they emit now and then a loud and rather shrill cry. Their food consists of fishes of small size, occasionally large dead fish, crabs, echini, asterias, and mollusca. In winter and spring they often travel in bands over the fields, searching the pastures, and especially ploughed lands, for worms, grubs, and insects.'"

Although, as a rule, Gulls have well-defined ranges for the separate species, the sub-family is very widely distributed, as might be anticipated in the case of such sea-loving birds, and there is no portion of the globe without its Gulls. The Skuas (*Stercorarius*) are also widely distributed, and are amongst the most rapacious and predatory of the Gulls. In Europe there are several species, the largest being the Great Skua (*S. catarrhactes*). In the Southern Ocean this species is replaced by a larger one, of a brown coloration, like its northern congener; this is the Antarctic Skua (*S. antarcticus*), and the Rev. A. E. Eaton, who went as naturalist to the last Transit of Venus Expedition, describes its habits in Kerguelen Island as follows:—"Every marsh near Royal Sound had its pair of Skuas. Many were destroyed within a radius of four miles from the ships, and before the expedition sailed from the island it was impossible to walk far without coming across dead bodies of the poor creatures. The cause of this useless slaughter was the menacing aspect of the birds, who swooped with fierce impetuosity directly towards the face of any one approaching their domain, rising only just in time to clear his head, and uttering short despairing cries. They did not feign to be crippled quite so much as the Skuas in Spitzbergen, but preferred intimidation as a means of averting danger from their nest. When they thought they had succeeded in making the enemy retreat, they celebrated their triumph standing face to face upon the ground, with their wings extended vertically so as almost to meet above their back, whilst one or two loudly chanted a pean, consisting of a dozen notes or so delivered in the tones of a Carrion Crow. In October they also used to croak now and then during their flight, and this croak, which was discontinued in the breeding season, was very like the lower croak of a raven; indeed, it was at first difficult to re-assure oneself that they were not a species of Crow as they circled in the air far off, and the blue-jackets used to call them 'Black Crows' for some time, but before long the designation 'Molly-Hawks' came to be applied to them. This change of name took place at the commencement of the Petrel-digging. If Blue Petrels (*Prion*) were turned loose in the day-time they were invariably chased by Skuas, and killed on the wing before they had flown half a mile. Petrels of one sort or another seem to constitute the staple food of these Skuas. They hunt for them in the evening when it is becoming dusk, flying rapidly along the hill-sides, close to the ground, like Hawks, ready to pounce upon any that they may see emerging from the mouth of their burrows. Again, in the early morning they are upon the wing to waylay Petrels returning from the sea. Nor are they idle during the rest of the day; and they are very fond of birds' eggs, of which they devour a great many. The old Skuas were much puzzled when they saw Rabbits come out of Petrels' holes. They hovered for a long time over their heads, and at length used to stand beside the mouths of the burrows waiting for the young ones to creep forth, just as if they were watching for Petrels. It is doubtful whether they will succeed in ridding the island of these mischievous vermin, although the young birds reared by me readily fed upon rabbits procured with the sling."

Besides the Great Skuas of the genus *Catarrhactes* there are several smaller kinds belonging to the genus *Lestris*, of more graceful build, and distinguished by long pointed tails.

THE SECOND FAMILY OF THE GAVLÆ, OR SEA-BIRDS.—THE PETRELS (*Procellaridæ*).

Professor Sundevall makes a group of the Petrels, which he calls *Tubinares*, on account of the tube-like apertures to the nostrils, which are peculiar to these birds. They are true denizens of the sea, being, as a rule, found far from land, and most of the specimens which find their way into our collections are obtained by catching the birds with hook and line as they follow in the wake of a ship in search of food, or by visiting the rocky islands or places where the Petrels resort for the purposes of nidification, and digging them out of their holes. With the exception of the Fulmar and a few small species, the Petrels are nearly all inhabitants of the Southern Ocean beyond the tropics,



SKUA.

where they may sometimes be seen in immense numbers and at a great distance from any land. They are supposed to be perfectly at home during the most violent storms, but it not unfrequently happens that they are driven on land by stress of weather, and are often picked up dead or dying not only on the sea-shore, but even some distance inland. The Stormy Petrel (*Oceanitis pelagica*) breeds in many places off the western coast of England, from the Scilly Islands up to the Hebrides, and it also nests on rocky islands off the north-western coast of Ireland. Wilson's Petrel (*O. oceanica*) is also found occasionally on British shores, but it is to the south that the naturalist must go to study the Petrels in their full profusion.

The family may be divided into three sections, the Diving Petrels (*Pelecanoides*), which have short wings and no hind toe; the True Petrels, with long wings and a hind toe always present, birds of sustained flight who swim and dive very little; and the Albatrosses (*Diomedea*), the largest of all the family. The Rev. A. E. Eaton gives a good account of the habits of the Diving Petrel (*Pelecanoides urinatrix*), which he met with in Kerguelen Island:—"This bird, as Prof. Wyville

Thomson well observes, has a close general likeness to the Little Auk, or Rotche (*Mergulus alle*), of the northern seas. Both of them have a hurried flight; both of them, while flying, dive into the sea without any interruption in the action of their wings, and also emerge from beneath the surface flying, and they both of them swim with the tail rather deep in the water. But this resemblance does not extend to other particulars of their habits. The Rotche, when breeding, usually flies and fishes in small flocks of six or a dozen birds, and builds in communities of considerable size, which are

STORMY PETREL.

excessively noisy. Diving Petrels, on the other hand, are more domestic in their mode of living, fishing and flying for the most part in pairs or alone, and building sporadically. They had begun to pair when we reached Kerguelen Island. The first egg was found on the 31st of October. Their burrows are about as small in diameter as the holes of Bank Martins (*Cotyle riparia*) or Kingfishers (*Alcedo hispida*). They are made in dry banks and slopes where the ground is easily penetrable, and terminate in an enlarged chamber, on whose floor the egg is deposited. There is no specially-constructed nest. Some of the burrows are branched, but the branches are without terminal enlargements, and do not appear to be put to any use by the birds. Before the egg is laid, both of the parents may be found in the nest-chamber, and may often be heard moaning in the day-time;

but when the females begin to sit, their call is seldom heard, excepting at night, when the male in his flight to and from the hole, and his mate on her nest, makes a considerable noise. There seems to be a difference of a semitone between the moans of the two sexes. The call resembles the syllable *oo*, pronounced with the mouth closed, while a slurred chromatic scale is being made from E to C in the tenor. This kind of Petrel has much difficulty in taking flight from ground which is comparatively level; it is only by running against the wind, or by starting from a lump of *Azorella*, that the birds are able to rise upon the wing if they happen to alight upon a flat. During my walks on calm nights I used frequently to hear them fluttering along the ground in the dark, and (if I had a lantern) easily caught them by uncovering the light and turning it on them. They sometimes lay still in my hand without attempting to escape; but when they flew off from it, they did so in a manner which showed that they were not at all crippled. They flew to light on board H.M.S. *Supply* on dark nights in October, when there was snow upon the deck."

The True Petrels are by far the most numerous of the family. They are birds of strong flight, and have very long and pointed wings, which enable them to traverse the sea with a light and fairy-like flight, many of them flying with their legs hanging downwards, and patting the waves over which they skim. The well-known Cape Pigeons (*Daption capensis*), the Fulmar Petrels (*Fulmarus*), and the Stormy Petrels (*Oceanitis*), are amongst the most familiar birds of this group; and of Wilson's Petrel (*O. oceanica*) Mr. Eaton gives an interesting notice in the "Report on the Transit of Venus Expedition" already alluded to:—

"From the 10th of October, when we passed Cape Sandwich, until the middle or third week of November, we completely lost sight of the Storm Petrels. About the period last mentioned, however, they began to frequent Observatory Bay in large numbers. Their first appearance in it took place during a strong breeze which lasted several days. When this was succeeded by more moderate weather we saw little of them in the day-time; but towards evening they used to fly over the water like Swallows, and some of them might be observed flying near the ground far away into the country, following the course of the valleys, or playing round the inland cliffs. We tracked them along the lower hill-sides and the margin of lakes over rocks and bogs; but our efforts to learn what became of them were unattended with success. Probably at that time they were not preparing to breed, and the birds were merely going overland from the bay to other inlets of the sea. At length, when we went to Thumb Peak, their mode of nesting was discovered. Carefully watching with Lieut. Goodridge, R.N., the birds flying to and fro about the rocks, we observed that they occasionally disappeared into crevices amongst piles of loose stones, and crept under loose masses of rocks. Having meanwhile ascertained their call, we were able, by listening attentively, to detect the exact position of several of these hidden birds. They were easily caught when the stones were rolled aside; but they were in couples, merely preparing for laying, and therefore we did not find any eggs. On our way back to Observatory Bay after the Transit we called at the American station, and were informed by Dr. Kidder that he had observed this Petrel on the shore near Molloy Point. The sea-shore in the neighbourhood of Observatory Bay is of a different character (for the most part) from that which is adjacent to the American station, and being less favourable than it, was seldom resorted to for nesting by the Petrels. But the country in general about our bay afforded them unlimited accommodation. For, provided that they can find a slope of shattered rocks, with suitable chinks and crevices, or dry spaces under stones, or large boulders, sheltered from draughts, whether they be near the Sound or on the summits and sides of high hills, they readily appropriate them. The egg is laid upon the bare ground within the recess selected by the birds, either in a chance depression formed by contiguous stones, or in a shallow circular hollow excavated in the earth by the parent. Having found numbers of their nesting-places, I will describe my method of searching for them. Whenever there was a calm night I used to walk with a darkened bull's eye lantern towards some rocky hill-side, such as the Petrels would be likely to frequent. It was best to shut off the light and keep it concealed, using it only in dangerous places, where falls would be attended with injury, and progress in the dark was hardly possible, lest the birds seeing it should be silenced. On arriving at the ground selected it was probable that the Storm Petrels would be heard in various directions, some on the wing, others on their nests, sounding their call at intervals of from two to three minutes. Those on nests could be distinguished from others flying by their cries proceeding from fixed positions.

Having settled which of the birds should be searched after, a cautious advance had to be made in her direction, two or three steps at a time, when she was in full cry. As soon as she ceased an abrupt halt was imperative, and a pause of some minutes might ensue before she recommenced her cry and permitted another slight advance to be effected. In the course of this gradual approach the position of the bird might be ascertained approximately; but it had to be determined precisely, and, to learn exactly where she was, she had to be stalked in the dark noiselessly. No gleam could be permitted to escape from the lantern. Loose stones and falls over rocks; to avoid them it was sometimes necessary to dispense with slippers and feel one's way in stockings only, for should the Petrel be alarmed once with the noise or the light she would probably remain silent a considerable time. Now and then it would happen that upon the boulder beneath which she was sitting being almost attained the bird would cease calling. When this occurred, and many minutes elapsed without her cry being resumed, it was advisable to make a detour, and approach the rock from the opposite side, as her silence might be attributed to her seeing a person advancing towards her, and she would probably recommence her call as soon as he was out of sight. If she did not, a small pebble thrown amongst some rocks would usually elicit some sounds from her, as she would most likely conclude that the noise was being made by her mate returning to the nest. When the stone beneath which the bird was domiciled was gained at last, redoubled care had to be exercised. By stooping down and listening very attentively her position could be accurately ascertained. Then the lantern was suddenly turned upon her before she had time to creep out of sight, and her egg could be secured with the hand, or with a spoon tied on to a stick. Sometimes I worked without a lantern, and marked the positions of the nests with piles of stones, so that they might be revisited by day. Several eggs were obtained in February from nests which had been thus marked early in the previous month. The first egg taken by us was found by a Retriever on the 22nd of January on an island in Swain's Bay. Captain Fairfax sent me a nestling a day or two before we sailed for the Cape. Two of the eggs were laid in unusual situations. One of them was found by a man under a pringlea plant; but this may have been an egg of *Procellaria nereis*. The other was deposited just above the tide-mark in a cavity of a rock rather open to the air and light. I had found the bird there one night, had taken her up into my hand, and had gently replaced her in the hollow, nearly a month before the egg was laid."

As already mentioned, the Albatrosses are the largest of the Petrels. The wings are extremely large, the Wandering Albatross having forty secondary quills alone, and this, with the hollow bones, renders these birds capable of sustained and buoyant flight equalled by no other living bird. Their beak is very large, and about equal to the head in length. Captain F. W. Hutton, who has paid great attention to the family of Petrels during his voyages in the Antarctic Ocean, has written a very full account of the habits of these fine birds, from which the following notes are extracted:—

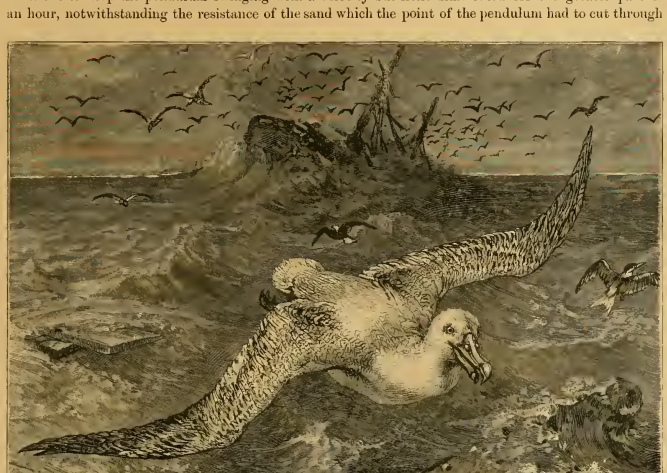
"The unrivalled flight of the Albatross has been the admiration of voyagers from the earliest time. Day after day with unabated interest I have watched them, and I quite agree with Mr. Gould that the Sooty Albatross (*Diomedea fuliginosa*) carries off the palm from all competitors. Never have I seen anything to equal his ease and grace as he sweeps past, often within a few yards, every part of his body perfectly motionless except the head and eye, which turn slowly and seem to take notice of everything. I have sometimes watched narrowly one of these birds sailing and wheeling about in all directions for more than an hour, without seeing the slightest movement of the wings; this, however, is longer than usual. Wonderful as is this power of flight, it can all be explained by the simple mechanical laws which govern the direction and magnitude of pressure. Dr. Bennett states that he believes that the whole surface (of the body of the Albatross) is covered by numerous air-cells, capable of voluntary inflation or diminution by means of a beautiful muscular apparatus. . . . By this power the birds can raise or depress themselves at will. Now, I do not for a moment doubt the existence of this apparatus, for it is well known that all birds have it to a greater or less extent; but I *do* doubt its capability of doing the duty assigned to it, viz., raising the bird in the air. The temperature of the Albatross, as taken by Sir G. Grey, by placing a thermometer under the tongue, is 98° Fahr., and if we add 10° Fahr. to this in order to allow for the difference between the head and the body, we shall have the temperature of the air-cells at 108° Fahr. The temperature of the surrounding air cannot be taken lower than 48° Fahr., as the mean winter temperature of Lat. 50 S. is about 50° Fahr.

The bird, therefore, could not raise the temperature of the air taken into these cells more than 60° Fahr. This would increase its volume not quite one-eighth; and taking 100 cubic inches of air to weigh 31 grains, and the average weight of an Albatross to be 17 lbs., as given by Gould, it would be necessary, in order that the specific gravity of the bird might be brought to that of the atmosphere, that these cells should contain 1,820 cubic feet of air; or, in other words, they must be more than 1,200 times the size of the body itself of the bird, which, to say the least, would give it when flying an aldermanic appearance which I have never observed. In fact, it would require a sphere of more than fifteen feet in diameter to contain the necessary quantity of air. Even if it could thus buoy itself up, it would entirely defeat its own object; for it would at once destroy the whole of its momentum, and unless propelled forward by its wings, would drift helplessly to leeward. However, I do not wish it to be inferred that I consider the air-cells of no use. The greater portion of them are situated round the neck, wings, and fore part of the body of the bird, and I believe that by their means he is enabled to shift slightly he position of his centre of gravity and thus, with very slight muscular exertion, to vary the inclination of his body to his horizon according to the rate at which he is moving through the air.

"Dr. Bennett, in his 'Gatherings of a Naturalist' (p. 78), gives a diagram explanatory of the flight of the Albatross," continues Captain Hutton; "and if I understand him rightly, says that 'it cannot sail directly against the wind, but only in the way which sailors call 'close hauled.' This diagram represents a square rigged ship sailing six points from the wind, a cutter sailing four and a half points, and an Albatross flying two points from the wind, from which I infer, although he does not expressly say so, that he considers that the wind helps forward the Albatross in the same way it does the ships. But that this is erroneous is apparent at a glance. A ship can sail at an acute angle with the wind because the pressure of the wind against its sails being met by the resistance of the water, is resolved into pressures having other directions. Advantage of this being taken by trimming the sails, it ultimately results that the ship is moved in the direction of least resistance, viz., forwards. If, however, the pressure of the wind had not been met by the resistance of the water, no resolution of it in other directions could have taken place. For this reason a balloon can only drift with the wind, and the same would be the case with the Albatross. Moreover, the statement that he cannot sail against the wind is incorrect, as Dr. Bennett himself said in his first book, 'Wanderings in New South Wales,' the truth being that he is more often seen sailing in this direction than in any other, for the simple reason that as he moves slower against the wind than with it, he is obliged to keep going for a longer time in the former direction than in the latter, in order to retain his position near the stern of the ship. However, when sailing against the wind, the position of his wings, body, and tail, slanting a little downwards, is somewhat analogous to the sails of a ship close hauled, or, still better, to the position of a kite in the air, the momentum of the bird taking the place of the resistance of the water, or the string of the kite. This momentum is entirely owing to impulses previously given to the air by means of his wings, and when, owing to the resistance of the air, it has decreased so much that he is no longer able to move with sufficient rapidity to prevent his falling, fresh impulses have to be given. For this reason Albatrosses sail much longer in fine weather, rain especially soon destroying their momentum, and frequently obliging them to use their wings for propulsion.

"It is by combining, according to the laws of mechanics, this pressure of the air against his wings with the force of gravity, and by using his head and tail as bow and stern rudders, that the Albatross is enabled to sail in any direction he pleases so long as the momentum lasts. If, when sailing against the wind the inclination of his body is such that the upward pressure of the wind against his wings and body just balances the force of gravity, his momentum alone acts, and he sails straight in the 'wind's eye.' If he wishes to ascend he inclines his body more to the horizon by means of his head and tail. If he wishes to turn to the right he bends his head and tail slightly upwards, at the same time raising his left side and wing and lowering the right in proportion to the sharpness of the curve he wishes to make, the wings being kept quite rigid the whole time. To such an extent does he do this that, in sweeping round, his wings are often pointed in a direction nearly perpendicular to the sea, and this position of the wings, more or less inclined to the horizon, is seen always, and only when the bird is turning. It will be observed that, on this principle, an Albatross sailing down wind must necessarily be descending, unless his pace is much greater than that of the air, and such I have found to be invariably the case.

"It may be objected that the resistance of the air must soon destroy his momentum; but the fact is that it does not do so. A good illustration of this is seen in an experiment common in lecture rooms a few years ago, by which the rotation of the earth was demonstrated by means of a pendulum, composed of a metal ball, suspended by a long string from the ceiling of the lecture hall. The impetus obtained by causing the metal ball to fall through the space of a few feet only was sufficient to keep the pendulum swinging with a velocity but little diminished for the greater part of an hour, notwithstanding the resistance of the sand which the point of the pendulum had to cut through



ALBATROSS.

twice during each vibration. The resistance of the air is well known to depend on the shape and velocity of the moving body, and to increase in proportion much more rapidly than the velocity increases. For this reason a properly shaped body and a low velocity are required to reduce it to a minimum. A certain amount of weight is also necessary to give a bird momentum sufficient to overcome resistance for a certain time, and wings are required of sufficient expanse to support it as it sails slowly through the air. These conditions are admirably carried out in the Albatross. Its expanse of wing is perhaps greater than that of any other bird, and its weight, 15 lbs. and upwards, is very large. Its shape also, when the neck is stretched out as in flying, approaches nearly to that of Newton's solid of least resistance, while more than one voyager has remarked the slowness with which it sails past. The Stormy Petrel never sails; the Cape Pigeon only for a very short time, perhaps a minute; the Night Hawk much longer, often between five and ten minutes; while the Albatross, as I have before mentioned, sails sometimes for an hour."

CHAPTER X.

DIVERS—PENGUINS—TINAMOUS—STRUTHIOUS BIRDS—LIZARD-TAILED BIRDS.

THE DIVERS—Characters—THE AUKS—The Great Auk—Probably extinct—The Razor-bill—The Guillemot—Mr. Seebohm's Notes of Visits to their Breeding-places—The Experiences of a "Climmer"—The Rotche—The Puffins—The True Divers The European Grebes—The Grebes—The Little Grebe, or Dabchick—The Dabchick's Powers of Diving—THE PENGUINS—Distinctive Features—A Penguin Rookery—Life in a "Johnnie" Colony—Their Nests Their Habits—THE TINAMOUS—Their Place in the Class Aves—Their Appearance—Habits—THE STRUTHIOUS BIRDS—Their Characters—Entirely Terrestrial—Odd Use of the Wing in Running—Feathering—Distribution—THE OSTRICHES—Characters—THE OSTRICH—Mention in History—Scriptural References—Distribution—How the Bushman Hunts the Ostrich—Method adopted in Morocco—Other Modes of Hunting—An Omnivorous Bird—Its Stride—Its Cry—Habits—Its Re-emblance to a Camel—The Feathers—Exportation of Feathers from Africa—A Visit to an Ostrich Farm—Use of "Incubators"—Habits of the Birds in the Enclosures—The Ostrich Dance—The Rheas, or American Ostriches—THE CASSOWARIES—Characters of the Cassowary—the Mooruk—Its Extraordinary Power of Leaping—Dr. Bennett's Account of its Habits—The Emus—Characters—Habits—Emu Beef—Threatened Extermination—Its "Booming" Note—THE KIWIS—Characters—Species—Dr. Buller's Account of its Habits—Mr. Bartlett's Note on its Attempts at Nesting—THE LIZARD-TAILED BIRDS—The Archæopteryx Lithographica Description—FOSSIL FORMS—Evidence from Foot-prints—Prof. Marsh's Researches in America—Birds with Teeth—Other Forms—Concluding Remarks.

THE ELEVENTH ORDER OF BIRDS.—THE DIVERS (PYGOPODES).

THE order of the Divers comprises not only those birds, but the Auks and Grebes, forming together a very natural group, which may be divided into three families. In all of these birds the wings are short and pointed, the quills being complete in shape, and not imperfectly developed, as in the Penguins, which in many respects the Auks and Grebes resemble. The feet are placed far back in the body, so that when the birds stand they are erect and have an awkward look. The tarsus is very short, but the toes are long. The tail is always small. The Auks and Divers are birds of the northern regions only, but the Grebes are more widely distributed, and are most of them more or less migratory.

THE FIRST FAMILY OF THE PYGOPODES.—THE AUKS (*Alcidæ*).

These birds have no hind toe, and are of a thick-set build, giving them somewhat of a clumsy appearance on land; but this is amply atoned for by their wonderful activity in the water. There are three sub-families of the Auks. The first contains the Razor-bills (*Alca*) and the Guillemots (*Uria*), the second the Little Auks (*Mergulus*), and the third the Puffins (*Mormon*, &c.). The Guillemots and Razor-bills have the region of the nostrils feathered and the bill rather longer. They are found in many portions of the Old and New Worlds, but always in northern localities, and where they breed both species often occur in very large colonies. The most interesting of all these birds is the Great Auk (*Alca impennis*), a species whose extinction in modern times is of the greatest regret to the true naturalist. Many people have fancied that the species will be re-discovered in the high north by some of the Arctic Expeditions, but this is extremely improbable, as the Great Auk never seems to have been a very northern bird. From the Orkneys and the Hebrides the bird reached Iceland, and then re-appeared on the coast of Newfoundland, where, during recent years, numerous semi-fossil remains have been unearthed. At one time the Great Auk appears to have been plentiful in certain of the above-named localities, but has been exterminated during the last fifty years. It was the largest of all the Auks, measuring quite two feet and a half. The Razor-bill (*Alca torda*), which is its nearest representative, is only about a foot and a half in length, and is by no means uncommon in the places in which it congregates during the breeding season. Writing of the breeding colonies of the Razor-bills and Guillemots on the Flamborough cliffs, Mr. Seebohm observes:—"The Razor-bill is by no means so plentiful as the Guillemot; nevertheless, in walking along the cliffs we may count them by hundreds, if not by thousands; and he is certainly a much handsomer bird. The contrast between the brilliant black of the upper plumage and the dazzling white of the under surface, the white marks on his black bill, and the general 'get up' of his whole plumage, as if he had just come out of a bandbox, or, to use a simile more appropriate for a naturalist, as if he had only just emerged from his chrysalis, and had not ruffled a feather, makes him quite the dandy of the cliffs. Alighted on a rock, which he is by no means particular should be horizontal, he is constantly looking about in every direction, his head never being still for a moment. Poor, unfortunate fellow! the sight of a 'cobble'

putting off from the shore is a signal for him instantly to leave the cliff and get out to sea as fast as his short legs will carry him; for he knows by experience that these 'cobbles' are generally full of 'sportsmen' (save the mark!), thirsting for his blood. The eggs of the Razor-bill are by no means so easy to obtain as those of the Guillemot. Instead of breeding on ledges easy of access, they prefer some hole or cranny in the cliffs, where the egg has generally to be poked out with a stick, or only admired at a safe distance. From the nature of the situation it is also obvious that the eggs are scattered up and down the cliff, and are not to be got in batches, like those of the Guillemot, whose eggs may often be collected by the dozen at a time on a single ledge. The Razor-bill's eggs, too, do not vary in colour to the extent that the Guillemot's eggs do, or even as much as those of the Gulls. They may, with very few exceptions, be roughly described as white with black spots; the white has sometimes a faint tinge of bluish-green or brown, and the black is sometimes greenish, and more frequently reddish. The Razor-bill, like the Guillemot, only lays one egg, and if that one is taken away it lays a second. It also breeds regularly in the same cranny, and each individual seems to lay the same variety of egg from year to year. I have two Razor-bill's eggs, taken at intervals from the same hole, which are twice the size of the ordinary egg, and I have also one which is extraordinarily small." We are also indebted to Mr. Seebohm for an account of the breeding habits of the Guillemot (*Uria troile*) in the Fern Islands and off the Flamborough cliffs. He observes:—"The first colony which we visited at the Fern Islands was that of the Guillemot. Whilst our little craft was scudding along before the wind, the mast bending to the sail, and sometimes too far removed from the perpendicular to be altogether agreeable to our landsmen's nerves, especially when our leeward bulwark dived just under water for a second or two, we could see some miles ahead a group of rocks, called 'The Pinnacles,' standing out conspicuously like great whitewashed rocks in front of one of the Fern Islands. To these rocks we now quietly rowed. They stood out some fifty feet from the cliffs, and were perhaps thirty or forty feet high, nearly perpendicular, and the summit of each a tolerably level platform, about twelve or fifteen feet square. The top and more than half-way down the sides was completely whitewashed with the excrement of the birds, and on the leeward side the smell of guano was strong, but not offensively so, as the lime almost overpowered the ammonia and entirely absorbed the sulphuretted hydrogen. The top of these 'Pinnacles' was one dense mass of Guillemots, and, as we approached, all became excitement. Streams of Guillemots poured off every corner in long strings, like Wild Ducks, but for some time the dense mass seemed to get no less. In every direction shoals of Guillemots were hurrying and skurrying away over the sea, almost as far as the eye could reach. Some desperate individuals took a header from the top of the rocks, and flinging out their legs so as to make a threefold rudder with the tail, plunged at once into the sea and dived out of danger. All this time the birds were protesting vociferously against our intrusion. By the time we had landed an anchor the rocks were nearly cleared, and for a mile or more away the sea seemed covered with them. The flight of the Guillemot is heavy and laborious, reminding one of that of a Kingfisher or a Hawk-moth. We were able to climb some distance up the 'Pinnacles,' and a good long ladder we brought with us from the next island landed us at the top. On the lime-washed top of each pinnacle were some thirty or forty eggs, looking exactly as if a smart breeze would sweep off the lot. Not the remotest vestige of a nest of any kind was there. The rock having been recently cleared of eggs, those we found were all nearly fresh laid, very clean, and looking most beautiful on the white rock; especially the dark green eggs. The Guillemot lays only one egg, and, indeed, it could not sit upon two, the egg being enormously large for the size of the bird, who does not seem to sit upon it on its breast, like a duck, for instance, but rests upright on its tail, like a dog begging. As we were leaving the rocks we saw an anxiously maternal Guillemot alight behind her egg, which, with a quiet poke of her bill, she pushed between her legs.

"The variety in the colour of the eggs of the Guillemot is something wonderful. We found the following varieties, and no doubt a greater opportunity of selection would double or treble the number, to say nothing of the additional varieties. Thirty eggs in my collection from the Fern Islands vary in the ground colouring from dark blue-green and pale blue-green to white cream colour. The character of the spots may be described as irregularly blotched, fantastically streaked, spotless, or nearly so." Mr. Seebohm has also kindly allowed us to make use of his account of his visit to the Flamborough cliffs, where there is another noted breeding-place for the Guillemots:—

"The cliffs at Bempton are very much like those at Flamborough: a nearly perpendicular wall of chalk and flint, about three hundred feet high. This great sea wall is fast crumbling away with the action of wind and tide. It looks as if it had been built of flints, with chalk for mortar, and sometimes there seems to be as much mortar as stone, and often there is scarcely any, and, in fact, it then looks like a dry wall. The outline of the coast is very irregular; some parts of the cliff are harder than others, and stand out to sea as promontories, while others are soft, and have apparently been washed away into caves and little fiords. Here and there the cliffs have cracked, and then you can look down, and in some places climb down, through the rift to the sea. The

RINGED GUILLEMOT.

top of the cliffs is covered with a thick bed of soil, which slopes steep down to the edge of the rock, and is generally grown over with grass cropped short by rabbits. This steep slope to the edge of the cliff is rather dangerous, and it is very rare indeed that you can get a view of the face of the rock except from the opposite promontory. On the ledges of these precipitous cliffs the Guillemots breed in great numbers. Sometimes one may see them in such quantities as to remind one of a swarm of bees. They fly about in all directions, and numbers are constantly arriving and others leaving the ledges, while far away in the sea, down at the bottom of the cliffs, hundreds of birds are swimming about. The whole scene is full of life.

"A party of 'climmers' consists of three, two at the top and one suspended in mid-air. The latter, in consequence of the greater risk he has to run, takes one-half of the eggs as his share. This adventurous man must have a clear head, or he would become dizzy; neither must he be too heavy, or he would tire out the two men who have to lower and raise him some two hundred feet or more, twenty times a day; while, at the same time, he must have a good knowledge of the various ledges and crannies where the birds breed.

"He first puts on what he calls his 'breeches,' a belt of flat rope with a small loop at each end to which the cord by which he is suspended is attached, and two large loops through which he puts his legs. An iron bar is driven into the ground, to which a rope is attached to hang down the cliff to assist him in raising himself, and with which to make signals to the men above when he wants them to raise him or lower him down. An iron pulley running on a swivel attached to an iron spike is fastened on the edge of the precipice, so that the rope may not chafe.

"The danger of 'climming,' *i.e.*, the danger of falling, is very slight indeed: the real danger consists in pieces of rock becoming detached and falling on the unfortunate 'climmer.' L. told me

ARCTIC PUFFIN.

he had 'clum' for six-and-thirty years, and had met with only one really serious accident. A piece of rock, about half the size of his head, detached itself some thirty feet above him, and, though he saw it coming, he could not get out of its way. If it had fallen on his head it must inevitably have dashed his brains out, but he put up his arm to protect himself. His arm was not broken, but the muscle was absolutely torn from the bone, and it was nearly two years before he could raise it to his head again. He divides his ground into three days' work, so that he takes it all twice a week, when weather permits; in very wet or windy weather he does not 'clim.' Operations commence about the 14th of May. For the first nine days he has a good run of eggs, as the birds that breed on the ledges he visits have most of them laid; for the next nine days eggs are scarce. At the end of that time a second egg has been laid by the birds whose eggs he took during the first nine days, and he has a second run of successful collecting. He considers from two to three hundred eggs a good take. He has then a second nine days slack, and after that comes his Midsummer fling, or 'shut.' This is a very precarious one, and in some seasons is not

worth the getting, while in others it is nearly equal to the first two takes. L. is of opinion that no Guillemot lays more than two eggs in a season; and it is much easier to obtain accurate information respecting the habits of birds at a place like Flamborough, where the birds are scattered over some miles of cliffs, than at the Fern Islands, where they are crowded together in a dense mass on only four rocks. He also informed me that each bird frequents the same ledge year after year, and lays the same-coloured egg every year, although the variety of colour in the eggs of different birds is wonderfully great. He tells me that he used to get a very rare and highly-prized variety of the Guillemot's egg, of an almost uniform rich reddish-brown colour, on a certain ledge twice every year, for fifteen years in succession, after which the poor bird died, or was shot, or became a 'shunted dowager.' The chief thing that strikes an ornithologist who has been accustomed to estimate the eggs of the Guillemot by the Fern Island standard, and afterwards visits Flamborough, is the extraordinary beauty and variety of colouring in the eggs found at the latter station. Not only are the colours more varied, but they are decidedly more brilliant."

In the second group of the Alcinæ are found the Little Auks (*Mergulus*). The best known species is the Rotche (*Mergulus alle*), a bird scarcely larger than a Thrush, though possessing the thick-set body and dense plumage of the Auk family. It is seen in large numbers in the northern seas, where it may be observed, even in rough weather, far away from land, cresting the billows or diving for food in every direction. It nests in communities on islands such as Spitzbergen and Novaia Zemlia, and is a common bird in Greenland. The third group of the Auks contains only the Puffins, some of which are rather handsome birds of their kind, a few of them having fine crests; while in the Common Puffin (*Mormon fratercula*) the bill is variegated with bright colours, the skin of which is shed at a certain period of the year. These birds also appear to be more migratory than the other Auks.

The second family of the Diving Birds contains the true Divers (*Colymbina*), which possess a hind toe and a very short rounded tail. The neck is long, differing much in this respect from the preceding family of the Auks, but, on the other hand, showing a great affinity to the Grebes. The Divers, however, are as much inhabitants of the ocean as the Grebes are of fresh water: and instead of being found all over the world, they are confined to northern latitudes, whence they migrate farther south in the winter season, but never quit the confines of the Palæarctic region in the eastern hemisphere, and the Nearctic region in the western. The great Northern Diver (*Colymbus glacialis*) is the largest of the three European species, but the other two are perhaps the best known—the Red-throated Diver (*C. septentrionalis*) and the Black-throated Diver (*C. arcticus*), both of which occur not only in Europe, but also in North America. Mr. Dresser gives a good account of the habits of the Red-throated Diver in his "Birds of Europe," where he writes:—"Water seems to be the element where this species and its allies are most at home; for on land it is extremely awkward, and moves along with difficulty and in the most clumsy manner; and though its flight is swift, yet it is, comparatively speaking, less frequently seen on the wing, except when on passage or on its way from one sheet of water to the other. But in the water its movements are graceful and easy, and whether swimming on the surface or diving below, it propels itself with great rapidity and ease. It swims low down in the water, and when uneasy or alarmed will submerge its body below the surface, leaving only the head and neck in view. When it dives it vanishes beneath the surface without noise or flutter, and propels itself along with its wings as well as its feet, frequently remaining for some time before it emerges to view again. When it flies up from the water it flaps for some short distance along the surface, splashing the water as it progresses, and seems as if it had a difficulty in rising into the air; but when once well under weigh it flies with great rapidity, its flight being direct, the neck stretched out horizontally. When flying any distance and when on passage, it proceeds at a great altitude, and may sometimes be heard uttering its peculiar loud cry, which, like that of its allies, is exceedingly weird and strange, resembling most the agonising shriek of distress uttered by a drowning person; and even when one is accustomed to hear this wild cry, one cannot always divest oneself of the feeling that something 'uncanny' is near, when in the dusk of the evening the wild weird shriek is suddenly uttered in the immediate vicinity. In some parts its cry is supposed to foretell the near approach of rain: but it appears chiefly to circle at a considerable altitude, uttering its cry, during rain. Though shy and very wary when it has been subjected to persecution, it is, as a rule, far less so than its allies; and when unmolested it is tolerably fearless. When in Finland I used very frequently to see the

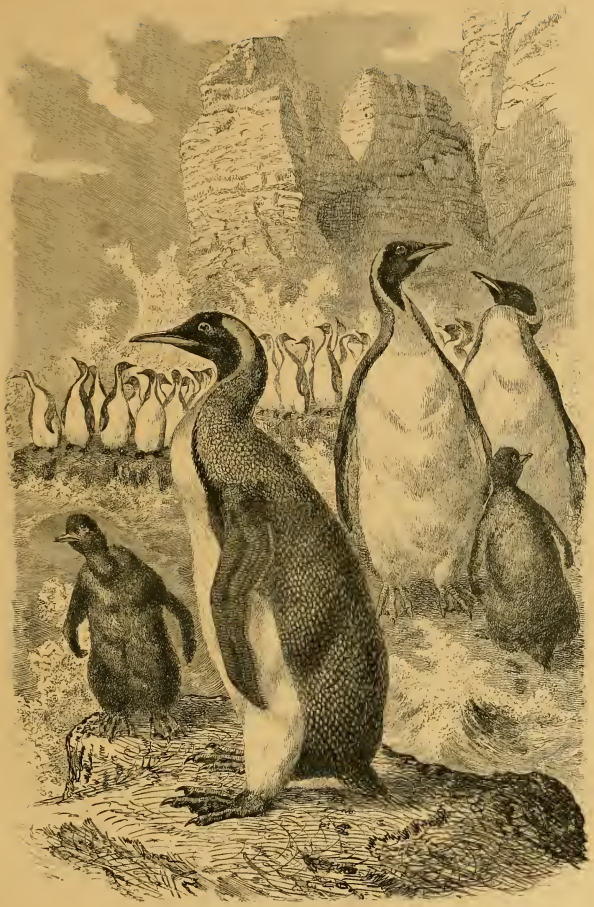
present species in the large lakes in the interior, and I have often reclined on a rock watching several Divers which were swimming and diving quite unconcernedly within a short pistol-range of me. During the spring I collected in northern Finland many eggs of this Diver, which breeds there not unfrequently. Its nest consists merely of a little grass or a few rushes collected in a small depression in the ground close to the water, and is usually placed on a small island or on the shores of an inland lake; or else, at the Gulf of Bothnia, on the shores of the gulf itself. Whether both sexes incubate I cannot with certainty say, because I never succeeded in surprising one on its nest; for its mate, which is seldom far off, at once gives the alarm, and the sitting bird takes to the water. If deprived of their eggs, the birds will remain about their despoiled home for some time, uttering loud melancholy cries, as if bewailing their loss." The same author describes the habits of the Black-throated Diver as being very similar to those of the red-throated species; and Mr. Robert Gray, a well-known Scottish naturalist, says that the natives of Benbecula and North Uist compare the cry of the latter bird to the words "*Deoch! deoch! deoch! tha'n loch a traoghadh!*" which may be interpreted as "Drink! drink! drink! the lake is nearly dried up!" Both the above-named Divers are more beautifully marked in summer than in winter, and at the latter season of the year the Red-throated Diver is completely white underneath, without any appearance of the red throat from which the species takes its name.

The third family of the Diving Birds embraces the Grebes (*Podicipitinæ*), which represent the before-mentioned Divers in fresh water. They are not unlike the Divers in shape, having a long neck and pointed bill, the hind toe being present and lobed, as also are all the other toes. They can scarcely be said to have a tail at all, only a little soft tuft of feathers representing this organ. The beautiful glossy plumage of the Grebes is well known as an article of dress, and ladies' muffs and jacket-trimmings are made out of the bodies of these birds, causing considerable slaughter among them for these articles of trade. Luckily, a Grebe is a bird which thoroughly understands how to take care of himself, and to capture him two things are necessary—first, to get within range of the bird, and secondly, to shoot him when once within distance, so that considerable patience is often required. The best known species in England is the Little Grebe, or Dabchick (*Podiceps minor*), which frequents most of the rivers, but more particularly affects fresh-water lakes. Here the bird is thoroughly at home, and its nest may be found by a little careful search. It is one of the most disagreeable nests to remove if required for a museum, and to all appearances most uncomfortable, if one did not remember the thoroughly aquatic habits of its owner. It is built entirely of weeds, stalks of plants, and reeds, and looks exactly like a lump of wet rubbish. Nor does a cursory examination dispel this idea, for many times we have passed by the nest, and seeing no eggs, have at first imagined that it was a disused one of last year, but on feeling under the layer of wet weed on the top of the nest the eggs have been discovered, very carefully and artfully concealed. This concealment is said to be the work of the birds themselves on seeing the approach of an intruder; it has, however, been asserted that the female having laid the eggs, covers them up with wet rubbish, and leaves the action of the sun to assist in hatching them. It seems to us difficult, in the case of the Little Grebe at least, to prove the truth of these statements. We have studied the nidification of this species under peculiarly favourable circumstances, and have found more than one nest every season for the last seven or eight years, and, notwithstanding our utmost caution in approaching the nest in the hopes of seeing the bird leave it, we never yet succeeded in surprising the female, but on arriving at the nest we found the eggs always perfectly hidden from sight by a mass of wet weed, which did not always show signs of having been hastily piled on, but in some instances at least appeared to have been flattened down on the top of the eggs. So quick to perceive danger, however, is the Dabchick, that the mere launching of a boat half a mile off is cause for alarm, and the pair of birds would have plenty of time to conceal their eggs before any one could get up unperceived. The eggs, when first laid, are white, but as incubation proceeds they get more and more discoloured, until at last they become of a dirty yellowish-buff colour. In summer the Dabchicks are much handsomer birds than in winter, for, like all Grebes, they put on a summer plumage, when the neck becomes red and the under-parts black, instead of silvery white. At this time of year they are somewhat more easily obtained, as they trust as much to concealment as to their power of diving; and if there is a little weed growing above the surface of the lake they often betake themselves to it for shelter, and as their bodies scarcely appear above

the water, their necks alone are left to attract attention, and these may often be detected even among the weed-stalks. In winter they assemble in little companies, probably consisting of the old birds and their families of the previous summer, and on the approach of danger they dive under water and disperse in different directions; there is, however, generally some place of refuge for which they make, perhaps a spot where the bushes overhang the water or a bed of rushes near the bank. They may, perchance, be intercepted on their way thither, but so sharp are the Dabchick's eyes, and so great the

CRESTED GREBE.

distance which he can swim under water, that out of twenty birds which may be seen swimming together at first, probably not more than half-a-dozen come again under the observer's eye. The little birds will, perhaps, appear on the surface as light as a cork floating, but only for an instant: the slightest movement in the boat and they disappear like lightning, so that frequently the only intimation one has of their presence is the splash and the ripple which indicate where the bird has gone down. Where it will reappear is quite a matter of conjecture, for, once under the water, it may press forward in any direction, and come up again fifty yards off in quite an unexpected quarter. We remember once finding a Dabchick feeding in a narrow ditch ending in a *cul-de-sac*, and posting ourselves at the end of the ditch, we waited patiently for the bird to appear, making sure that we should



GIANT PENGUIN.

shoot it without fail; but the Grebe, nothing daunted, dived under water, came straight down the ditch, passed us at a point where it was not more than six yards broad and about two yards deep, and reappeared in the river about twenty yards off, diving the instant we moved, and coming up again far out of shot. This is only one instance out of many we could relate which have occurred to ourselves in our chase after Dabchicks, when the birds have saved themselves by their adroitness in swimming and diving. Besides the Little Grebe, there are found in England the Great Crested Grebe (*Podiceps cristatus*), and in winter the Red-necked Grebe, the Eared Grebe, and the Sclavonian Grebe sometimes occur. Most of the Grebes are migratory, and some are very widely distributed, occurring over nearly the whole surface of the globe. One of the most remarkable is the South American species (*Centropelma micropterum*), from Lake Titicaca, in the Bolivian Andes, a bird of large size, but with such small wings that it cannot fly.

THE TWELFTH ORDER OF BIRDS.—THE PENGUINS (IMPENNES).

The Penguins represent in the Southern Ocean the Auks and Divers of the Northern Seas. They are called *Impennes* on account of their wings, which are very small in comparison with the size of their bodies, and quite hard in texture, very rigid, and movable only at the base, and covered with small stiff feathers of a bristly nature. The body is long and flat, of an oblong form, and the bird swims with a wavy motion, using its feet and wings as auxiliary portions of the body. The Penguins are found on some of the rocky islands in immense numbers, and Dr. Bennett gives a good idea of a Penguin rookery in Macquarie Island, where they occupied about thirty or forty acres of ground:—"The number of Penguins," he writes, "collected together in this spot is immense, but it would be impossible to guess at it with any near approach to truth, as during the whole day and night 30,000 or 40,000 of them are continually landing, and an equal number going to sea. They are arranged when on shore in as compact a manner and in as regular ranks as a regiment of soldiers, and are classed with the greatest order, the young birds being in one situation, the moulting birds in another, the sitting hens in a third, the clean birds in a fourth, &c.; and so strictly do birds in a similar condition congregate, that should a bird that is moulting intrude itself upon those that are clean, it is immediately ejected from among them." During the late expedition to Kerguelen Island numbers of Penguins were found nesting on the island, and the Rev. A. E. Eaton writes as follows concerning the species known as *Pygoscelis taeniata*:—

"The Johnnie (as the whalers call this bird) is common in Royal Sound. It builds in communities, some of only a dozen, others from 70 to 150 families. A more populous colony upon the mainland was visited by six officers from the ships, who estimated the number of nests in it to amount to 2,000 or more. These larger communities are approached from the sea by regular paths, conspicuous at a distance, like the well-worn sheep tracks, which lead straight up the hill from the water. Their formation is due to the Penguins being very particular about where they land and enter the sea. A small party of the birds occupied a position upon the neck of a low promontory, within an hour's walk of Observatory Bay. Their nests were nearest to the farther side of the isthmus, but when they were approached the male birds used to run to the water, not by the shortest route, where it was deep close to the rocks, but by the longest, to a place where the shore was shelving. It was amusing to see them start off in a troop as fast as their legs could carry them, holding out their wings, and tumbling headlong over stones in their way, because as they ran they would keep looking back instead of before them, and to hear their outcries. Panic and consternation seemed to possess them all, but the females (possibly because they could not keep up with their mates) seldom went far from their nests; and if the intruder stood still, soon returned and settled down again upon their eggs. Not many weeks had passed before a change was effected in their conduct. The young were hatched, and now the mothers anxiously endeavoured to persuade them to follow the example of their fathers, and run away to sea. But the nestlings preferred to stay in their nests; they did not mind if the stranger did stroke them, although their anxious mothers did run at him with open mouths whenever he dared to do so. Only a few of the older chicks could be prevailed upon to stir, and they, after waddling a few yards, became satisfied with their performance and turned to go home again. The mothers who had straggled to a greater distance began to return too. It was now that the more

tardy youngsters began to experience the ills of life. Every Penguin that had reached its place before them aimed blows at them as they passed by towards their own abodes. One of the little birds certainly did seem to deserve correction. It saw its neighbour's nest empty and sat down in it. The old female Johnnie, the rightful occupier, presently returned, in company with her own chick, to whom, having put her head well into his mouth, she began to administer refreshment after his run. Seeing them so pleasantly engaged, the small vagrant thoughtlessly, presuming on her generosity, went nearer and presented himself to be fed also, as if he had a right to her attention and care. She looked at him while he stood gaping before her with drooping wings, unable for a moment to credit what she saw. But suddenly the truth flashed upon her, and, provoked by his consummate audacity, she gave vent to her indignation, pecked his tongue as hard as she could, chased him out of the nest, darting blows at his back, and croaked ominously after him as he fled precipitately beyond the range of her beak, leaving trophies of down upon the scene of his unfortunate adventure. The whole of this community of Penguins was subsequently boiled down into 'hare soup' for the officers of H.M.S. *Volage*, and very nice they found it.

"The nests were composed of dried leaf stalks and seed stems of Pringlea, together with such other suitable material as happened to be at hand. There were two eggs in every nest, and one of them was invariably larger than the other. Most likely the birds hatched from the larger eggs are of the opposite sex to those which are produced from the smaller. Whether the big or the little egg is the first to be laid was not ascertained.

"As is the case with many other kinds of birds, Johnnies are very regular in their habits. Every afternoon at nearly the same time they repair to the shore when they have done fishing, landing in small parties at their accustomed places at the heads of shallow inlets. On issuing from the water they dispose themselves to rest, seldom proceeding beyond the verge of the shore. Those which are inclined to sleep put their heads behind their flippers; the others stand amongst them with the neck shortened so as to bring the head down close to the body, with the beak slanting upwards and forwards, somewhat in the manner of a very young Thrush during repose. Their eyes present a rather tearful appearance, and resemble bits of dull black glass set in their heads—perhaps the nictitating membrane may be kept drawn over them. At frequent intervals a kind of watery fluid is ejected from their mouths by a shake of the head. I was led to suspect that these Penguins are liable to be attacked by Seals, for in places not much frequented by man, if they once effect a landing they do not readily return to the water on being alarmed, but run away from the sea uphill as fast as they can go. After they have gone some distance, they turn round and look back while they take breath; but as soon as they are rested sufficiently they willingly resume the ascent. It is not until they have been driven so far as to become thoroughly tired that they refuse to proceed farther, but when this stage has been reached it is useless to urge them to advance without a pause. As they face about, the sight of the boot ready to push them over is greeted with deprecating sighs, and should this be disregarded, and they be sent over upon their backs, as soon as they regain their feet they rush at their driver, launch their bill at his knees, beat their wings furiously against his calves and shins, and make a dash on all-fours down the hill at full speed to regain the sea. When they became accustomed to being chased by men, the Penguins acquired the habit of betaking themselves to the water at the first alarm. A small party of these birds used persistently to land in Observatory Bay every evening at the very time when the men erecting our huts were returning to the ship after their work. Such of the Johnnies as managed to escape being caught one day were sure to reappear the following evening just at the critical time, dragging themselves out of the water to afford sport to the men. By the time that the huts were completed, the survivors were reduced in number to a couple of birds, and there can be little doubt that these would have followed their late companions into the soup-kettle had the putting up of the Observatory occupied one more day. The cry of the Johnnie distantly resembles the short bark of the fox."

THE THIRTEENTH ORDER OF BIRDS.—THE TINAMOUS (CRYPTURI).

It seems at first sight strange that the Tinamous, so much resembling game-birds in their appearance, should be placed almost at the end of the series of birds, and so far from what would be considered their natural allies; but in reality they form an extremely interesting group, inter-

mediate in some respects between the Carinate birds and the Struthious birds (*Ratitæ*). They may briefly be described as game-like birds, having the bones of the skull like the Struthiones, but having a keeled sternum, which places them in the Carinate series.

The Tinamous are strictly neotropical in their habitat, and do not occur away from the South American region. The body is thick and the head small, the bill is slender, a little shorter than the head itself, gently curved and depressed, the tail small and often concealed by the coverts, the wings short and rounded. About forty species of Tinamous are known to science at present, and these are divided into nine genera. Many of the birds are found only in forests, while others, on the contrary, frequent open grass-lands, and have the habits of the European Quails. The eggs are very striking in their coloration, being sometimes of a very deep purplish shade, whilst in some instances they are bluish-green; the texture is always smooth and very glossy, and when once seen a Tinamou's egg can hardly be mistaken. On the ground these birds run with great rapidity, and seldom endeavour to save themselves by flight, while their intelligence appears to be of a low order, and when suddenly alarmed they seem to become stupefied with fear. On such occasions, as we are informed by Mr. Darwin, a man on horseback, riding round and round them so as to narrow the circle each time, may knock over as many as he pleases, but the usual way to capture them is by means of a small lasso or running noose, made of an ostrich feather fastened to the end of a stick; and a boy thus armed and riding on a horse has been known to secure as many as forty in a day. The Tinamous are much appreciated as articles of food, and they have on this account been much harried, so that species which were once common in some countries have now to be sought for at long distances from their former haunts. This has been the case with the Tataupa (*Crypturus tataupa*), in the neighbourhood of Buenos Ayres, and the late Mr. Durnford stated that it was not to be met with within a hundred miles of that city. This species, according to the late Prince Maximilian of Neuwied, prefers open quarters to forest land, and runs with great speed over the ground. Towards evening it utters a very peculiar cry, consisting of two long-sustained notes, followed by six or eight of the same tone, but short and quickly repeated. The species of *Nothura* are more Quail-like in their habits, and have been designated by some authors the American Quails. Of the *N. maculosa*, near Buenos Ayres, Mr. Durnford writes that it is resident and abundant wherever the rough paja-grass or thistles afford any cover. It also frequents fields of maize or other cereals in considerable numbers. On a Sunday or holiday it is a curious sight to watch the "sportsmen" of various nationalities flocking to the different railway stations to have a day's "perdiz" shooting. The dogs impressed into their service are, like their masters, of various breeds—from a Bull-terrier to a Pointer—it being considered of primary importance to be accompanied by some specimen of the canine race. When collecting in the Chuput Valley in Patagonia, the same naturalist fell in with the Elegant Tinamou (*Calodromas elegans*), which he found common in the valley and on the hills in very dry spots. It nests under the shelter of a small bush, and after scraping a slight hollow in the ground, lines it with a few fragments of grass and feathers, laying sometimes as many as ten eggs. The remarkable character of these, of a uniform pea-green colour, with a highly polished appearance, is well known. About dusk these birds come from the shelter of the long grass or bushes, where they have lain during the day to feed; and at that time they can be heard calling to each other in every direction. Their note is a loud and oft-repeated whistle, uttered in a low key.

DIVISION II.—THE STRUTHIOUS BIRDS (RATITÆ).

The characters which distinguish the *Ratitæ* from the Carinate birds, or *Carinatæ*, were briefly alluded to at the commencement of the present article,* and consist chiefly in the absence of a keel to the sternum, which is therefore raft-like. The Struthious birds are amongst the largest of the class, and are entirely terrestrial in their habits, not one of them being able to fly, though they make up for this deficiency by an extremely swift power of running, and in some of the species the tiny wings are elevated so as to form a kind of sail, which helps the bird along, when fleeing from danger. A good idea of the speed at which these birds can go is given in Mr. Smelt's description of the chase of a Rhea, or South American Ostrich (*Rhea americana*), on the pampas,

* Vol. III., p. 239.

in the district of Tapalqueen, on the south-western frontier of Buenos Ayres, where the species is tolerably numerous, and is hunted by Europeans with dogs, and by the Indians with the well-known "bolas," or balls:—"We soon found," he says, "that the report we had heard as to the abundance of Ostriches here had not been exaggerated, and that in whatever direction we went we were sure of finding them. After riding for about a mile and a half, we viewed five birds feeding in a hollow, at a distance of about seven or eight hundred yards from us, and discovered that by skirting some high grass to our left we should most probably be able to get close to them without alarming them; so we at once started in that direction, taking two of the dogs with us. Before we had gone a couple of hundred yards we came suddenly on an old male bird, a splendid fellow, and we slipped the dogs within five-and-twenty yards of him. Then began one of the most exciting runs it was ever my good fortune to witness. Away we went, through the thick 'pajas,' or tufts of high reedy grass, the hounds keeping well up, and apparently rather gaining ground than otherwise. In this way we ran for two miles or more, when the Ostrich, emerging from the high grass, steered away across some bare hills, where he got the full force of a very fresh breeze that was blowing at the time, of which he at once took advantage, running down and across it in an oblique direction, with his left wing raised, which he made use of as a sail. The pace hitherto had been good—in fact, I may say, without fear of exaggeration, more than good—but now that he had got the wind, it was simply racing, and, in spite of all our efforts, and those of the dogs, he seemed to leave us literally as though we were standing still. We kept pounding away, however, in pursuit, as well as we could, for some time, when a man who was driving cattle turned him to the right, and he headed straight back towards us for a few seconds before he found out his mistake; we were thus enabled to get on good terms with him again. After running for about fifteen minutes more, he began to show unmistakable symptoms of distress, and one of the dogs, a large brindled one, ranged fairly alongside, and was about to make a spring, when he doubled as short as if he had been fixed on a movable pivot, and catching the slant of the wind, and setting his wing again, he was off like a flash of lightning, and leading by nearly a quarter of a mile, the hounds having shot lengths ahead before they could turn. It was evident, however, that he was tiring fast, and, although the pace was still good, we got alongside again, but with no better result than another double, and another good lead for the bird; and these tactics he continued to repeat each time we neared him, always gaining an immense advantage thereby. It became plain, however, that he could not last much longer, and eventually the dogs pinned him, when we rode up and gave him his *coup de grâce*, cutting off his wings as trophies." The accounts of hunting the Ostrich in Africa which are given by travellers are very similar in character to the above account of the Rhea hunt, and the extract has been made principally to illustrate the use of the wings as a help to the bird when it runs. The feathering of the Struthious birds is most peculiar, and when viewed from a little distance the birds look as if they were covered with hair instead of feathers. This appearance is enhanced by the loose character of the plumage, the feathers being very long and lax, while they have none of the little barbules* which hook the cross barbs together, and tend to make the feather of an ordinary bird firm and compact in itself.

The distribution of the Struthious birds, to judge from the fossil remains which have been found, was at one time much more extended than it is at the present day. They seem, however, to have always been developed to a greater degree in the southern portions of the globe, and never to have penetrated very far north. This is amply demonstrated by the presence of a large number of forms of Moa (*Dinornis*) in New Zealand, and the gigantic *Æpyornis* of Madagascar, which were as much larger than the Ostriches of the present day as the latter birds are than the majority of birds now living.

The *Ratitæ* may be divided into two families, the Ostriches (*Struthionidæ*), amongst which the Cassowaries are classed, and the Apteryges (*Apterygidæ*). These families have well-marked characters for their distinction.

THE FIRST FAMILY OF THE STRUTHIOUS BIRDS.—THE OSTRICHES (*Struthionidæ*).

In all these birds the bill is short, though powerful and robust; it is rather flattened, and has a large "nail" at the tip. The nostrils are longitudinal, and are situated at the base of the bill. The

* See Vol. III., p. 238.

eyes are large, and are protected by well-developed and stiff eyelashes. The legs are extremely stout, and no hind toe is ever represented. The Ostriches may be further divided into two sub-families.

THE FIRST SUB-FAMILY OF THE STRUTHIONIDÆ.—THE OSTRICHES (*Struthioninæ*).

The principal character which distinguishes the Ostriches from the Cassowaries is the absence of a second feather or highly-enlarged after-shaft,* which in the latter birds is as long as the feather itself, and forms a second plume. The wings, too, are feathered, the plumes being large and tolerably long, while the tail feathers are small and not greatly developed. The two genera belonging to this sub-family are *Struthio* and *Rhea*, the former containing the African Ostrich (*Struthio camelus*), the latter the Rheas of South America, of which there are three species.

THE OSTRICH (*Struthio camelus*).

Interesting as the natural history of the Ostrich has been from time immemorial, regarded as one of the birds mentioned by the most ancient writers, it is doubtful whether the latest phase of the history of the Ostrich, viz., its domestication in "Ostrich Farms," will not prove of greater importance to mankind than its existence in a state of nature. To Mr. Julius de Mosenthal's book on "Ostrich Farming," and the monograph on the "Struthious Birds" by Mr. J. E. Harting, the author is indebted for the following statements condensed from these works:—The Ostrich, although it seems in ancient times to have extended to India and Central Asia, is not known to inhabit those countries in the present day, but within the Christian era eggs of this bird, and even some living examples, were brought to China from Turkestan and Central Asia, and the King of Samarkand is mentioned as having paid a tribute of Ostriches' eggs to China in the year A.D. 605. Remains of the species have been found in the Sewalik Hills, in North Western India, along with those of the Camel and the Giraffe, but it is doubtful whether the Ostrich ever extended into India within historic times, as no mention is made of it in Sanskrit literature, while the bird is not alluded to during the celebrated march of Alexander the Great through Asia; at the same time, Mr. Surtees, who resided for some years in Sindh, is stated by his friend, Canon Tristram, to have heard of many traditions pointing to a former existence of the Ostrich in that country. In Syria, Arabia, and Mesopotamia, it seems to have been known from time immemorial, and Sir Henry Layard informs us that Ostrich feathers appear as ornaments on the robes of the figures in the oldest sculptures of Nimrod, together with the emblematic flower, and frequently occur on the Babylonian and Assyrian cylinders, from which we may conclude that the Ostrich was a sacred bird. It is frequently mentioned in Scripture, where, however, according to Canon Tristram, the Hebrew word is often rendered as "Owl." Some of the references to the habits of the bird are true to nature, and others are based on popular beliefs which hold even to this day among Orientals. "It is the hoarse complaining cry by night," writes Canon Tristram, "to which Job compares his own sorrowing lamentations under the visitation of God. The same simile occurs in Micah i. 8: 'I will wail and howl, I will go stripped and naked: I will make a wailing like the dragons, and mourning as the ostriches' [owls, marg.]. In the reply of the Lord to Job, the habits of the Ostrich are thus set forth: 'Gavest thou the goodly wings unto the Peacocks? or wings and feathers unto the Ostrich, which leaveth her eggs in the earth, and warmeth them in dust, and forgetteth that the foot may crush them, or that the wild beast may break them? She is hardened against her young ones, as though they were not hers: her labour is in vain without fear; because God hath deprived her of wisdom, neither hath he imparted to her understanding. What time she lifteth up herself on high, she scorneth the horse and his rider.'—Job xxxix. 13—18. Here we find mention made of the beauty of its plumes, of its habit of leaving its eggs on the surface, of hatching them in the heat of the sand, of its desertion of its young, of its reputed stupidity, and of its extraordinary fleetness."

Xenophon, in his "Anabasis," mentions the occurrence of Ostriches in the plains of Artemisia, on the left bank of the Euphrates, in the neighbourhood of Thapsacus, but according to Olivier, who travelled there towards the close of the last century, they are no longer found there; but they are killed every year not far from Damascus, and they are still hunted in many parts of Arabia, though

* See Vol. III., p. 238.

everywhere in Western Asia the Ostrich seems to be a rapidly-decreasing bird. Canon Tristram states that even at the present day the bird occasionally wanders from Arabia towards the Belka, to the south-east of Palestine, and he himself obtained a specimen there, shot by Sheikh Agyhle Agha.

In Egypt and Nubia the Ostrich is now seldom found, and it scarcely ever occurs north of 17° N. lat. In 1816 Burckhardt saw many wild Ostriches in the plains of El Mograh, between Cairo and Suez; but Von Heuglin searched for them in vain in Central Egypt and the Lybian Desert, though he was informed by Prince Halim Pasha, a "trustworthy hunter," that he had found freshly-disturbed Ostrich nests and breeding-places within a few days' journey from Cairo. The species is found from Southern Algeria throughout Africa to the interior of Cape Colony, wherever an open country suits its nature, and where increasing cultivation and persistent hunting have not driven it away.* They are not found, for instance, on the West Coast of Africa, which is girt by a belt of forest land, nor do they occur in many parts of the East Coast, like Zanzibar and Mozambique, such skins and eggs as are sold in these places being brought from the interior. Some ornithologists consider that there are two species of Ostrich in Africa, and the late Mr. Andersson affirmed from his own experience that two, if not actually three, kinds of Ostrich were to be met with in South Africa alone. In one species he states that the male is black, while the female is grey, and in the second species the male is like the same sex of the ordinary kind, but is rather larger, while the female is jet-black like the cock bird. The existence of the third species depended very much on native testimony, but Mr. Andersson was inclined to believe in it.

The mode of hunting the Ostrich is different in various parts of Africa. In ancient times Strabo speaks of a tribe in Lybia, which he calls *Struthiophagi*, or Ostrich-eaters, who used to cover themselves with an Ostrich-skin, and thrusting the right arm into the skin of the neck, which they held aloft, by this device easily approached their game and killed it. Similar to this in some respects is the well-known method of the Bushman, who clothes himself in the skin of one of the birds, and imitates their motions so exactly that it is almost impossible to detect the difference at a little distance off. The sham bird approaches from the leeward side of the flock, for if once a bird winds him off it goes, and all the trouble is taken for nothing. "Now it turns its head as if keeping a sharp look-out; now it picks at the verdure on the ground, or at any water-melon or shrub which may be in its path; now it shakes its feathers, sometimes trotting and sometimes walking, until at length the wary Bushman gets within bow-shot of some unlucky bird, and when, having discharged his arrow, one of the flock runs off in any direction, the sham bird runs off too. The rest of the flock are quite unable to understand why their comrade should suddenly run away and then lie down, and they allow their enemy to follow them up until they share the same fate. Several are often secured in this way before they get scent of the impostor." In Morocco the only way to approach the Ostrich is on horseback, as no artifices can be employed, the birds being so wary and the plains so vast on which they are found. The horses are stated by Canon Tristram to undergo a long and painful training—abstinence from water as much as possible, and a diet of dry dates being considered the best means of strengthening their wind. The hunters of the tribes to the east of the M'zab set forth with small skins of water strapped under their horses' bellies, and a scanty allowance of food for four or five days judiciously distributed about their saddles. As soon as the birds are descried, two or three of the hunters follow the herd at a gentle gallop, endeavouring only to keep the birds in sight, without alarming them or driving them at full speed, when they would soon be lost to view. The rest of the pursuers leisurely proceed in a direction at right angles to the course the Ostriches have taken, knowing by experience their habit of running in a circle. Posted on the best look-out they can find, they await for hours the anticipated route of the game, calculating upon intersecting their path. If fortunate enough to detect them, the relay sets upon the now fatigued flock, and frequently succeeds in running down one or more, though some of their horses usually fall exhausted in the pursuit. The bird, when overtaken, offers no resistance beyond kicking out sideways.† Ostriches are also captured by the Bushmen by means of pit-falls or with the lasso, and the Somali tribes hunt in the same way. The birds are often shot at the pools to which they resort for drink, and they seem to be fond of standing in the water in the heat of the day, Von Heuglin having stated that Ostriches often resort to the

* Dr. Hartlaub, in the "Vögel Ost Afrika's," by himself and Dr. Finsch, gives a very good monograph of the Ostrich.

† Harting, "Ostriches," &c., p. 46.

shores of the Red Sea for this purpose. A well-directed charge of swan-shot aimed at the necks of the stooping birds will often lay several low at once. Another plan of capturing the Ostrich by the Bush-man may be noted. On finding the nest, he removes the eggs and seats himself in it, when he is able to shoot the bird on her return with his poisoned arrow before she can recover her surprise at the intru-sion. In Sennaar Ostriches are occasionally brought down by a kind of boomerang. In Arabia the birds are killed on the nest, the hen sitting very close and cowering over the eggs, with neck out-stretched, and its eye fixed motionless on the approaching enemy. When killed, it is laid upon the eggs, and the hunter, having buried the blood of his first victim, lies in wait till sunset for the return of the male, when the latter is also slaughtered.

The Ostrich appears to be a very omnivorous bird, and one which died in the Zoological Gardens in all probability owed its fate to 9½d. worth of copper money which it had swallowed. In a wild state it also swallows quantities of stones, sand, bones, and even pieces of metal, which are picked up indiscriminately; its natural food is also very varied, consisting of seeds, berries, fruit, grass, leaves, beetles, locusts, small birds and animals, snakes and lizards. Dr. Livingstone estimates the rate at which the Ostrich travels at about twenty-six miles an hour, reckoning each stride at twelve feet, but Canon Tristram measured the bound when the bird is at full speed as from twenty-two to twenty-eight feet. The cry is likened by Canon Tristram to the hoarse lowing of an ox in pain, and by other observers to the roar of a lion; in the Scriptures it is alluded to as a "wailing."

The Ostrich is gregarious, and appears to be more so in South Africa than in North Africa, where it is seen in little companies of from four to six individuals, the scarcity of food having, perhaps, something to do with the different habits in the latter locality. It is also a polygamous bird, each cock bird associating with three or four hens, all of which lay their eggs in one large nest scooped out in the sand, and relieve each other by turns at incubation, the male taking his turn at sitting as well as his wives. In the breeding season the males fight vigorously for the possession of the females. Though each hen bird lays a large number of eggs in the nest many more are dropped in the neighbour-hood, and Mr. Layard states that these are supposed to be broken by the parents as soon as the young are hatched, and serve for their first meals. The little ones come into the world under a certain amount of risk, for the cock bird often becomes impatient towards the end of the period of incubation, which lasts about six weeks, and has been observed to lean with his chest upon an egg, crack it, then take it up in his beak by the membrane inside the egg, and shake it violently until the young bird dropped out, when he would swallow the membrane, and repeat the operation on another.

The Ostrich was called the "Camel-bird" by the ancients, and its peculiar legs and head, with the great eyelashes shading its large eyes, were doubtless the cause of its being considered by Aristotle and Pliny to be partly bird and partly quadruped; and it resembles the Camel, not only in frequenting the same localities, but in many other points. The hard pad-like covering to the breast-bone of the Ostrich is analogous to the large callous pad on the Camel's chest, both the bird and the animal re-posing on their chests when they lie down. The diaphragm is also largely developed in the Ostrich. Nor does the resemblance to the Camel end here, for even in life there is evidence from modern European travellers of a likeness sufficient to account for the ancient name. Mr. Palgrave met with Ostriches in North-west Arabia, and writes:—"When we saw them far ahead, running in a long line one after the other, we almost took them for a string of scared Camels." Again, the Rev. A. C. Smith, in his "Attractions of the Nile," observes as follows:—"When seen at a distance moving over the desert, the camels struck me as resembling in a most remarkable degree their desert companion the Ostrich. It may seem strange to say that a bird and a quadruped have the same profile, yet such is undoubtedly the fact with these two denizens of the same sandy wilds; both hold their heads very forward, with necks much elevated and stretched out; then the long legs of the Camel are all near together, whereas those of the Ostrich are wide apart, and the result is that, seen at a distance, these two very different creatures might be easily mistaken for each other."

In the same work on Ostriches and Ostrich-farming, from which so much of the above information has been derived, is a full account of the last-named pursuit, which has become a considerable branch of industry. The value of the plumes is in these days principally appreciated by ladies, but in old times it was the male sex that mostly used them as adornments. Not to mention the Prince of Wales's feathers of England, a badge adopted by the Plantagenets, the feathers of the Ostrich are

mentioned in far more remote ages, appearing on the Egyptian hieroglyphical monuments, where they are spoken of as *shoo*, and they were used by the Egyptians as emblems of justice, from the webs being equally balanced and of equal width on each side of the shaft. "Warriors," says Mr. Harting, "wore Ostrich plumes in their helmets from a very early date. In the comedy of 'Acharnenses,' which was

OSTRICH.

represented in the Theatre of Bacchus at Athens (B.C. 425), Aristophanes depicted a general called Lamachoo, who carried two beautiful white Ostrich feathers in his helmet; while both the Greek Theophrastes (Hist. Plant. iv., 5) and the Roman Pliny clearly indicate that Ostrich feathers were thus used in their day." The noble Roman ladies are said to have kept domesticated birds for the purpose of riding, and still earlier the Egyptian Queen Arsinoe, who lived some time before the celebrated Cleopatra, had her statue erected on Helicon, in which she was represented as riding on an

Ostrich, and the bird is said to be capable of bearing a full-grown man. The writer has himself seen a light kind of carriage drawn by an Ostrich, in the Jardin des Plantes, at Paris. Although this purpose is not likely to come into vogue in the present day, the demand for food may bring Ostrich flesh into use, as it is said to be good eating, while the eggs are of the bulk of twenty-four common hens' eggs, and an omelette is pronounced by travellers to be very palatable.

When, in 1876, Mr. de Mosenthal wrote his report, Ostrich feathers, to the value of more than £600,000, were exported from Africa, and they were classified under thirty different headings according to their colour, size, and weight.* The largest exportation comes by way of Egypt, which contributed nearly half of the above amount; the Cape followed closely, Barbary came next with one-sixth of the whole sum, Mogador with a value of £20,000, and lastly Senegal, with a value of £3,000 only. The finest feathers are those received from Aleppo; they come from the Syrian desert, and are the most perfect in plumage, breadth, grace, and colour, but are very rare. The feathers from the Cape are as white as the Aleppo ones, but are much inferior in quality, and are surpassed by those of Barbary, Senegal, Egypt, and Mogador, whilst the most inferior are the plumes from Yemen, in Arabia, which are described as very thin and poor. The Cape seems to afford the best artificial breeding grounds, but in Algeria Ostrich-farming is being attended with success; while, so far, the attempts made in Australia have not turned out very productive. Mr. de Mosenthal's book contains an interesting account giving by Mr. Hillier of a farm kept by Mr. Douglas, at Hilton, near Graham's Town, South Africa, and from it we make the following extract:—

"After breakfast we began, on foot at first, to make our round of the various Ostrich troops and flocks, scattered or located as they are over a farm of some 3,000 morgen (6,000 acres); and as we shall require the aid of the artificial memory afforded by the recollection of the way we went, we will tell our story in that order, beginning where we began, with the first flock of the year's chickens we came to. The first chickens of this year were hatched in the early part of the month of August, and these, with others hatched during the following month or six weeks, now run together, and form a flock of forty-four fine healthy growing birds. Some of them are very large for their age, and all are remarkably lively and in good condition. It was very amusing to see how they gathered round the coloured boy who looked after them. They ran away to him if startled in any way, and came eagerly at his call.

"It was evident that their instincts had accepted him in the place of their original parents. These birds are now housed every night, and though this will no doubt be prudent for some time to come, on account of storms, yet some of the oldest look quite able to take care of themselves. In fact, were they with the parent birds, they could not be gathered, many of them, under their wings, or otherwise much defended from the cold. This group of young birds are kept in the home field, and, we believe, occasionally get a little lucerne. The condition and health of this flock of birds are most satisfactory. It proves most triumphantly that Ostriches hatched by machine, when the operation is properly conducted, are equally healthy with those that come into the world by the old-established and ordinary process; and that the same set of conditions must have been complied with, and the various necessary manipulations which instinct teaches the old birds to perform must have been successfully imitated, in artificial incubation. We think Mr. Douglas told us he had lost but one since they were hatched, and this by accident. The next troop of this year's birds is a flock of sixteen. They looked to us about a month old, but we were not told their age. These, too, looked exceedingly healthy. A boy was in attendance, and will continue so a little longer, till they are strong enough to join their little brothers and sisters. This little family is carefully housed every night in a warm covered stable. We forgot to say that the older flock are put in a kind of kraal within the shed, into which they can run when it rains. By this plan they get gradually accustomed to sleep out at night. The next flock we saw was the baby flock of fourteen, some of which were only a day or two old, while some were a week or ten days. These were exceedingly pretty little things, like giant young partridges, but with the special peculiarity of having little bristles all over them mixed with their down. They were very lively, and gathered round their guardian, and were some of them fed with a little cut lucerne. We were told that for the day or two after their birth they do not eat, but seem

* Since then the value has fluctuated to an extraordinary degree, according, presumably, to the dictates of fashion.

to be looking about curiously upon the great world they have so strangely come into. Then, after two days, they begin to attend to the duties of life by setting up a mill. This is precisely the fact. The little things, taught by instinct, eat no food till their gizzards are prepared, for which purpose they go about picking up little hard stones, of no doubt the exact kind required. After this preparatory process is completed they eat a little soft green food. This infant flock is gathered into a warm room at night; some of the youngest are put into the 'mother' crib of the incubator, whilst others are accommodated with a lodging between blankets, or otherwise comfortably provided for. We find, by adding together the above flocks, that we have some seventy-four chickens, all hatched since August by the incubator—all alive and well.

"We next mounted our horses, and proceeded to an enclosure separated by the river from the home ground. In this enclosure we found fifteen full-grown birds, or mostly full-grown, among which were an old cock and two laying hens, and possibly a pullet, which Mr. Douglas told us he thought was just beginning to lay. The old cock was very savage and fightable, and was given some mealies (maize) to amuse him while we rode quietly by. The old fellow attacked his master while on horseback some little time ago. He succeeded in getting his breast up to the horse, and kicked most furiously; but, owing to the unusual position he had attained, his kicks went for nothing, except once, when his toe ripped open the skin of the horse's flank, which set the horse going in turn. The fact is, that if the old birds only knew how to use their beaks as well as their feet, they would be most dangerous animals. As it is, though they peck off your hat, and pull your ears, their operations in this way do not amount to much. These fifteen birds have a large enclosure all to themselves. And here we may as well say that there are no sheep on the farm, and in the enclosures dedicated to the Ostriches, except in the home field, no other kind of stock. We next, after a mile, more or less, came to an enclosure in which were a very fine old cock and two laying hens. Here we were shown a nest, after due precaution having been taken to decoy the old monarch into a pen with some mealies, and safely shut him up; but we must confess that we gave one or two rather anxious looks towards the pen aforesaid, thinking it just possible that he might get out of it and come and look after us. The two hens were both sitting down, which we were informed they do; also, that when one goes to lay, the other goes to keep her company, though we did not inquire whether that was the etiquette of Ostrich life, or the special habits of these two birds. We were informed that the hens lay their eggs somewhere round about the nest—that is, within a few yards, and that the cock bird trundles them along, and places them in due order in the nest. In fact, the male Ostrich seems the very antipodes of roosters and drakes, for he takes the chief solicitude about the future of the eggs, placing them in the nest, and always sitting on them by night, with warding and divers other little attentions and performances necessary to a successful issue of incubation, which our good friend Mr. Douglas has carefully observed, after much patient watching, and has duly made a note of. Here we saw a fine nest of eggs, and proceeded to count them, but were stopped with the information that they would never hatch. No! never. And why? Simply because they were artificial; and so good is the imitation, that they deceived not only novices like ourselves, but even the Ostriches, who ought to have known better.

"Out of the enclosure, given up to the exclusive use of this polygamous family of three, we entered through a locked gate into a large enclosure, or paddock, in which were fifty-eight one- and two-year old birds. They all looked exceedingly well, and though they did not dance, they seemed full of life. They do sometimes favour the spectators with a dance, and it is one of the funniest of all the freaks or habits of animals that evidence a sense of the jokeful we ever beheld. We once saw some twenty nearly full-grown birds waltzing together. They began with a sort of sidling slow revolution on their toes, moving their wings gently up and down, and presently they seemed to get into the spirit of the thing without the aid of any fiddler that we saw, and span round at a rate that would have astonished any one but a dancing dervish. In dancing, they swept round and round without ever coming into contact with each other. Our fifty-eight young friends soon seemed anxious to make our acquaintance, or, perhaps, to see if there were any mealies, and they came up all round us, some two or three at a time, poking their little and long necks right into one's face. Quite docile and quiet, yet they seemed very inquisitive, and we should fully have expected, had we indulged in such vanities, to have seen our diamond breast-pin

disappear as a specially valuable stone to furnish grinding power for the bird. It is a queer feeling to be in the middle and under the inspection of some fifty-eight pairs of eyes or more, with a good sharp bill between each pair that could easily appreciate—or say, borrow—any little thing they take a fancy to. It was queer, but it was most satisfactory, for here were birds two years old, machine-hatched, and in size, health, and quality everything that could be desired. This completed our round of observation, in which we saw a good many contrivances for feeding, plucking, and general management, the result of much thought and patient investigation. Since the farm has had no sheep upon it the veldt has very much improved, and no doubt is still progressing in the same satisfactory direction."

The Rheas, which are the remaining representatives of the sub-family *Struthioninæ*, are distinguished by having three toes, while the head and the neck are fully feathered, and there is no tail visible. They are confined to the Central and Southern portion of the Neotropical region, and the three species of the genus *Rhea* are the Common Rhea (*R. americana*), which ranges from Bolivia, Paraguay, and South Brazil down to the Strait of Magellan, Darwin's Rhea (*R. darwini*), which replaces the foregoing bird in Eastern Patagonia, and the Long-billed Rhea (*R. macrorhyncha*), the exact habitat of which is as yet unknown. The habits of these South American Ostriches are not unlike those of their African relative, but as the feathers are not of such beauty as in the latter species, a lesser exportation of plumes takes place from South America. They appear, however, to be as capable of domestication, and an excellent account of their breeding in England is given by Mr. Harting.

THE SECOND SUB-FAMILY OF THE STRUTHIONIDÆ.—THE CASSOWARIES (*Casuarinæ*).

The Cassowaries and the Emus, which compose the present sub-family, are distinguished by the wings and the feathering of the body. The former are bare, and are represented only by some stiff horny shafts of large size, and the after-shaft, or second feather on the body-plumes, is very long, and almost equal to the feather itself, so that it has the appearance of being a double feather.

The Cassowaries have three toes, with the claw of the inner one elongated and sharp, while on the head there is a horny casque: otherwise the head is bare. Nine species of Cassowary are now known to science, and they are all peculiar to the Papuan sub-region, that is, to New Guinea and the adjacent islands, Northern Australia having one species also. These birds inhabit the thick forests, and are very shy in their native haunts, as well as being of a fierce disposition, using both beak and legs dangerously in striking. They always kick in front, elongating the body at the same time, while the Emu kicks outward and backward. Their habits are not very well known, the most familiar species being the Mooruk, of New Britain (*Casuarius bennetti*), which is captured by the natives and reared by hand; and the inhabitants of the Aru Islands also keep Cassowaries in confinement. It is probably owing to this means, and to the uselessness of the birds as articles of trade, that they are preserved to the present day, as the limited range of each species would conduce to its speedy extermination if hunted to death. Like the Ostrich and the other flightless birds of this order, the Cassowaries are very timid and shy, and of the Mooruk Dr. Bennett writes:—"They are exceedingly swift of foot, and possessed of great strength in their legs. On the least alarm they elevate the head, and on seeing danger, thread localities where no human being can follow them, and disappear with incredible rapidity. The Mooruk, with its powerful legs and muscular thighs, has an extraordinary power of leaping, and it was from this circumstance that the first specimen brought from New Britain was lost. One day, when allowed its liberty, it made a spring on the deck and went overboard. As it was blowing a strong breeze at the time the bird perished. Their wings aid them in running, but are never used for defence. The Mooruk is a robust bird, and differs from the Ostrich in its internal anatomy, its digestive organs being adapted only for a soft and nutritious diet—fruits, vegetables, insects, and eggs—grain or any similar hard substance not being digestible unless it had been previously boiled. It also requires a quantity of small gravel or pebbles to aid in the trituration of its food, and often picks up snails and small bits of iron for a similar purpose. I never heard them utter a sound like *Mooruk*. I am inclined to consider that the name signifies in the native language 'swift,' resembling closely the Malay term 'a muck,' or mad career; and the extraordinary rapid movements of these birds rather confirm my idea on this subject. The chirping sounds of the Mooruk are very

AMERICAN OSTRICH, OR RHEA.

peculiar, being modulated according to the urgency of their wants and desires. Sometimes these notes are varied, as if speaking; at one time they are mild, at another very vehement; then rising to a higher and more rapid chirp, as if scolding; afterwards becoming plaintive, as if beseeching for something; again loud and rapid, as if impatient at delay. At a little distance this modulation of the chirping notes seems as if the birds were holding a conversation, and has a very singular effect."

Both the male and female Cassowary sit on the eggs, which are of a beautiful green colour, the texture being rough and covered with small round tubercles. The period of incubation in the Mooruk,

CASSOWARY.

according to observations at the Zoological Gardens, is about fifty-two days. For the Ceram species (*C. galeatus*), Mr. Wallace gives the period as "about a month." In addition to the shape of the helmet or casque, the Cassowaries are classified according to the number of the pendent wattles on the neck, which are two in number in four of the species, one only in the fifth, *Casuarius uniappendiculatus*, of Salawati, and in the remaining four they are absent altogether. These wattles and the adjoining skin of the neck are generally of a bright colour—blue and green and red.

The Emus (*Dromæus*) are the only remaining examples of the *Casuarinæ*, but they may be distinguished by their feathered head and neck, the absence of a casque or helmet, and by the stout curved nails to the toes. Only two species are known, the Common Emu (*D. novæ hollandiæ*), and the Spotted Emu (*D. irroratus*), the former being widely distributed in the Australian Continent, while the latter is found only in Western Australia. There are several points

in which the Emus differ from the Ostriches in habit: for instance, they pair, and the male remains attached to a single female instead of being polygamous, and the female Emu is also the larger bird of the two. Writing of the Common Emu, Mr. Gould says:—"Its flesh has been compared to coarse beef, which it resembles, according to Mr. Cunningham, both in appearance and taste, and is good and sweet eating; nothing indeed can be more delicate than the flesh of the young ones. There is little fit for culinary use upon any part of the Emu, except the hind

EMU.

quarters, which are of such dimensions, that the shouldering of two hind legs homeward for a mile distance once proved to me as tiresome a task as I ever recollect to have encountered in the colony. I may remark that its flesh proved of the greatest service to Dr. Leichhardt and his intrepid companions during their overland route from Moreton Bay to Port Essington, in the course of which, but more particularly between the head of the Gulf of Carpentaria and Port Essington, the sight and capture of the Emu was almost a daily occurrence; so abundant, in fact, was it, that he states that he saw in the short space of eight miles at least a hundred, in flocks of three, five, ten, and even more at a time. On the continent of Australia the Emu was formerly abundant about Botany Bay and Port Jackson Harbour; but is now only to be seen

in the plains of the interior, over whose solitudes it roams in great numbers, and where it breeds, depending on the strength and swiftness of its legs to avoid the pursuit of the stockmen and their dogs. Farther and farther back, however, will it be driven, until it be extirpated, unless some law be instituted to check its wanton destruction.

"The note of the Emu is a low booming or pumping noise, which we know is produced by the female by means of the expansion and contraction of a large membranous bag surrounding an oblong opening through the rings of the trachea. The eggs, which are placed in a cavity scooped in the earth, generally in a sandy soil, are six or seven in number, of a beautiful dark-green, resembling shagreen in appearance, five inches and three-quarters in length by three inches and three-quarters in breadth. They are held in much esteem by the natives, who feed upon them whenever they can be procured."

The Spotted Emu (*D. irroratus*) has often bred in captivity in England, and a very interesting account of the acclimatisation of this species in Surrey has been written by Mr. William Bennett, of Betchworth.

THE SECOND FAMILY OF THE STRÜTHIONES.—THE KIWIS (*Apteryx*).

In these curious birds, whose native home is New Zealand, one meets with many characteristics of the Ostriches, while at the same time there are many points in which they differ from them. They are not so large as the smallest Cassowary, the biggest species of the genus, the Large Grey Kiwi (*Apteryx haasti*), being only about two feet in height; the neck and feet are also proportionately shorter than in the Ostriches and Cassowaries. The bill is very long and smooth, the nostrils being placed at the very tip, a peculiar provision in these birds, which, as will be seen presently, plunge the whole of the bill into the ground in search of their food. The plumage of the body much more resembles hair than feathers, both to the sight and touch, and the wings are so completely hidden, that the bird appears to have absolutely none at all.* There is no after-shaft to the feathers of the body, and the toes are four in number, the hind toe being elevated above the level of the others, very short and thick, and having the nail a little smaller than on the other toes.

Four species of *Apteryx* are known to Science, two of them being of a reddish-brown colour, and two of a grey plumage. The North Island in New Zealand possesses two of the species, and the South Island two, as follows:—The North Island Kiwi (*Apteryx mantelli*) is represented in the South Island by the *Apteryx australis*, while Owen's Apteryx (*A. owenii*), or the Little Grey Kiwi of the South Island, is replaced in the North Island by the Large Grey Kiwi, or Haast's Apteryx (*A. haasti*). It is doubtful, however, whether the larger birds ought to be considered anything more than bigger races of the smaller species. Dr. Buller has given a good account, as far as it goes, of the habits of *Apteryx mantelli*, but the great difficulty in observing these birds in a state of nature renders our knowledge of their economy rather meagre. The above-named gentleman writes:—"The Kiwi is in some measure compensated for the absence of wings by its swiftness of foot. When running it makes wide strides, and carries the body in an oblique position, with the neck stretched to its full extent and inclined forwards. In the twilight it moves about cautiously and as noiselessly as a rat, to which, indeed, at this time, it bears some outward resemblance. In a quiescent posture the body generally assumes a perfectly rotund appearance; and it sometimes, but only rarely, supports itself by resting the point of its bill on the ground. It often yawns when disturbed in the daytime, gaping its mandibles in a very grotesque manner. When provoked, it erects the body, and raising the foot to the breast, strikes downwards with considerable force and rapidity, thus using its sharp and powerful claws as weapons of defence. The story of its striking the ground with its feet to bring the earth-worms to the surface, which appears to have gained currency among naturalists, is as fanciful as the statement of a well-known author that it is capable of inflicting a dangerous blow, sometimes even killing a dog.

"While hunting for its food the bird makes a continual sniffing sound through the nostrils, which are placed at the extremity of the upper mandible. Whether it is guided as much by touch as by smell

* Hence its name, *Apteryx*, from the Greek ἀ, not, and πτέρυξ, a wing.

I cannot safely say; but it appears to me that both senses are called into action. That the sense of touch is highly developed seems quite certain, because the bird, although it may not be actually sniffing, will always just touch an object with the point of its bill, whether in the act of feeding or of surveying the ground; and when shut up in a cage or confined in a room, it may be heard all through the night tapping softly at the walls. The sniffing sound to which I have referred is heard only when the Kiwi is in the act of feeding or hunting for food; but I have sometimes observed the bird touching the ground close to, or immediately round, a worm which it had dropped, without being able to find it. I have remarked, moreover, that the Kiwi will pick up a worm or piece of meat as readily from the bottom of a vessel with water as from the ground, never seizing it, however, till it has just touched it with its bill in the manner described. It is probable that in addition to a highly-developed olfactory power, there is a delicate nervous sensitiveness in the terminal enlargement of the upper mandible. It is interesting to watch the bird, in a state of freedom, foraging for worms, which constitute its principal food: it moves about with a slow action of the body, and the long flexible bill is driven into the soft ground, generally home to the very root, and is either immediately withdrawn with a worm held at the extreme tip of the mandibles, or it is gently moved to and fro by an action of the head and neck, the body of the bird being perfectly steady. It is amusing to observe the extreme care and deliberation with which the bird draws the worm from its hiding-place, coaxing it out, as it were, by degrees, instead of pulling roughly or breaking it. On getting the worm fairly out of the ground it throws up its head with a jerk and swallows it whole. The stomach of a recently-killed wild bird which I dissected contained a hinau-berry (*Elæocarpus dentatus*), and rounded fragments of white quartz. Dr. Day writes me:—'In its very muscular stomach I have usually found the remains of beetles, pebbles, and many kernels of the hinau-berry.'"

The Apteryx has been known to lay in confinement, but up to the present time no young birds have been hatched in a state of captivity. Mr. Bartlett contributed to the Zoological Society an account of the *Apteryx mantelli*, and its attempts at nesting in the Zoological Gardens. "During last year" (1867), writes Mr. Bartlett, "these birds showed symptoms of a desire to pair. This was known by the loud calling of the male, which was answered by the female in a much lower and slower note. They were particularly noisy during the night, but altogether silent in the daytime. On the 2nd of January the first egg was laid, and for a day or more the female remained on the egg, but as soon as she quitted the nest the male bird took to it, and remained constantly sitting. On the 2nd of February the second egg was laid, the female leaving the nest as soon as the egg was deposited. The two birds now occupied the two opposite corners of the room in which they were kept, the male on the two eggs in the nest under the straw, the female concealed in her corner, also under a bundle of straw placed against the wall. During the time of incubation they ceased to call at night, in fact, were perfectly silent and kept apart.

"I found the eggs in a hollow formed on the ground in the earth and straw, and placed lengthwise, side by side. The male bird lay across them, his narrow body appearing not sufficiently broad to cover them in any other way. The ends of the eggs could be seen projecting from the side of the bird. The male continued to sit in the most persevering manner until the 25th of April, at which time he was much exhausted, and left the nest. On examining the eggs, I found no trace of young birds. Notwithstanding the failure of reproducing the Apteryx, I think sufficient has been witnessed to show that this bird's mode of reproduction does not differ essentially from those of the allied Struthious birds, in all cases of which that have come under my notice, the male bird only sits. I have witnessed the breeding of the Mooruk, the Cassowary, the Emu, and the Rhea, and the mode of proceeding of the Apteryx fully justifies me in believing the habits of this bird to be in no way materially different from those of its allies."

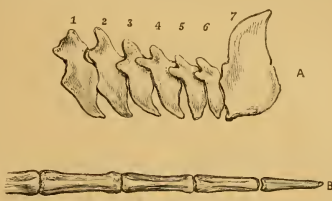
THE THIRD DIVISION OF BIRDS.—THE LIZARD-TAILED BIRDS (SAURURÆ).

Only one representative of this division is known, and that a fossil one, the *Archæopteryx lithographica*. The first evidence of the existence of a bird in strata of Oolitic age was furnished by the discovery of the impression of a single feather in a slab of lithographic stone from Solenhofen in Bavaria, described and figured by Hermann von Meyer in 1861, and named by him *Archæopteryx*. Later on in that year, the greater portion of the skeleton of an animal was discovered in the same

KIWI.

formation at Solenhofen, with impressions of feathers radiating fan-wise from each anterior limb, and diverging obliquely in a single series of a long tail. The characters of this singular feathered fossil seemed so unlike those of a bird, that Professors Andreas Wagner and Hermann von Meyer concluded that the animal in question was most probably a feathered reptile and not a bird at all.

Happily for British palæontologists, this remarkable fossil was secured for the National Museum in 1862, and a memoir on it was contributed by Professor Owen to the *Transactions of the Zoological Society* in the same year. The specimen is preserved in intaglio and relievo, on two slabs of Solenhofen limestone, the lower one of which represents the ancient surface of what was once tidal mud, upon which the carcase of the bird was left after its death, the upper being composed of the layers of alluvium deposited by subsequent tides, and to these we are indebted for the preservation of the fossil. The impressions of the feather are most beautifully preserved upon the lower slab, exhibiting the tail and wings, and some further portions of the skeleton itself. The head, neck, and dorsal vertebræ alone are wanting. The right scapula and humerus, and both the fore-arms, are well preserved. Two of the fingers of the wing appear to have been free, and to have been armed with sharp recurved claws. In modern birds the anterior of the three digits of the pinion remains free, and in some species supports a claw or spur —as, for instance, in many of the Thrushes a tubercle, or small callosity, can be felt with more or less distinctness. Several Plovers and Jacanas have spurs, as also the Spur-winged Geese (*Plectropterus*), while the Screamer (*Palamedea cornuta*) has two spurs, and the Megapodes have a tubercular rudiment of a pinion-claw.



BONES OF TAIL OF (A) BENGAL VULTURE AND OF (B) ARCHÆOPTERYX.

ARCHÆOPTERYX LITHOGRAPHICA.

The lower right limb is well preserved, consisting of femur, tibia, and tarso-metatarsal bones. To the latter bone four toes are articulated, one hind toe and three fore toes, the latter armed with sharp recurved claws. The foot agrees with that of a true perching bird, but from the fan-wise and rounded arrangement of the wing-feathers, it would appear to have been a bird of feeble flight. The most singular characteristic of this Oolitic bird is its tail, which is complete, and consists of no fewer than twenty narrow elongated vertebræ, the dimensions of which slowly but constantly diminish, so that the last is the smallest. The feathers of the tail are attached in pairs to each vertebra throughout its entire length. In most recent birds we find the tail very short and powerful, composed of vertebræ varying from five to nine in number, with well-developed spinous processes on their upper and under side, the last vertebra being very peculiarly formed, and, with few exceptions, it is always the *largest*. This last joint, called the *os coccygis*, or plough-share bone, is composed of two or more coalesced vertebræ, and gives attachment to the rectrices or quill-feathers of the tail, besides supporting the oil-glands. The above woodcut exhibits the peculiar ending to the tail of *Archæopteryx*, as compared with that of a recent bird.

Before concluding this article, it remains to say a few words on the Fossil Forms,* which are very few in number. With regard to Palæontology, the numerous papers published by Professors Owen and Huxley in Great Britain, Professor Alphonse Milne-Edwards in France, and the masterly researches carried on by Professor O. C. Marsh, of Yale College in America, have thrown a flood of light upon the ancient forms of the class Aves, before almost wholly unknown, and have to a great extent removed those barriers which seemed before to separate birds completely as a class from the rest of the Vertebrata.

That the presumed existence of birds at the period of the Secondary rocks should have been first intimated by their footprints may seem strange, but as far back as 1835, a notice appeared in "Silliman's Journal," stating that Dr. Deane had discovered impressions *resembling the feet of birds* upon some slabs of red sandstone from Connecticut. Dr. Hitchcock was the first who submitted these tracks to careful scientific investigation, and concluded that they had been produced "by the feet of birds." These gigantic three-toed footprints have been found in more than twenty places, scattered through a tract of country nearly eighty miles in extent, and they are repeated through strata more than one thousand feet in thickness.† Upwards of two thousand of these Ornithichnites had been observed and examined by Professor Hitchcock several years ago; but notwithstanding the most diligent and careful search, not a vestige of organic remains of either bird or pterodactyl has as yet been discovered in these beds. Numerous coprolites occur in the Connecticut rocks, and Dr. Dana has very ingeniously argued, from the analysis of their bodies, that, like guano, they are the droppings of birds rather than of reptiles.

The fossil footprints exhibit regularly, where the joints are seen, the same number as exists in the feet of living three-toed birds, and in each continuous line of tracks the three-jointed and five-jointed toes are placed alternately outwards, first on one side and then on the other. In some impressions, besides the three toes in front, the rudiment of the fourth toe is seen behind. It is not often that the matrix has been fine enough to retain impressions of the integument, or skin of the foot, but in one specimen found by Dr. Deane at Turner's Falls, on the Connecticut River, these markings are well preserved, and were recognised by Professor Owen as resembling the skin of the Ostrich and not that of reptiles.

Later researches, however, tend to prove that these footprints are not, after all, those of birds; for Professor Marsh, in his address to the American Association for the Advancement of Science, in 1877, remarks:—"A careful investigation of nearly all the specimens yet discovered, has convinced me that there is not a particle of evidence that any of these fossil impressions were made by birds. Most of these three-toed tracks were certainly not made by birds but by quadrupeds, which usually walked upon their hind feet alone, and only occasionally put to the ground their smaller anterior extremities. I have myself detected the impressions of these anterior limbs in connection with the posterior footprints of nearly all of the supposed 'bird-tracks' described, and have little doubt that they will eventually be found with all. These double impressions are precisely the kind which Dinosaurian reptiles would make, and as the only characteristic bones yet found in the same rocks belong to animals of this group, it is but fair to attribute all these footprints to Dinosaurs, even where impressions of fore-feet have been detected, until some evidence appears that they were made by birds. I have no doubt that birds existed at this time, although at present the proof is wanting."

Of the *Archæopteryx* from the Oolitic beds we have already spoken, and passing on from the Oolitic to the Cretaceous formation, we still find remains of birds exceedingly rare. But, just as in the preceding series of beds, land-surfaces and fresh-water deposits are few in number, and terrestrial organic remains are consequently uncommon. In 1840, under the name of *Cimoliornis diomedeus*, Professor Owen described a leg and a wing-bone of a longipennate natatorial bird, equalling the Albatross in size: but the subsequent discovery by Dr. Bowerbank of several additional bones and a part of the head, led that careful observer to conclude that these remains belonged to a pterodactyl, and not to a bird, as first supposed by Owen. As long ago as 1858, true bird-remains had been discovered by Mr. Lucas Barrett in the Upper Greensand, near Cambridge, a formation

* For assistance in this portion of the article the author is indebted to his friend, Dr. Henry Woodward, F.R.S.

† Lyell's "Manual of Geology," 5th Edition, p. 348.

extensively worked for phosphate of lime extracted from coprolite nodules. Portions of the metacarpus, metatarsus, tibia, and femur have been detected and named by Professor Seeley *Enaliornis* (*Pelagornis*) *barretti*. Professor Newton believed them to be the remains of a true bird, having some resemblance to a Penguin. These are the only bird-bones of Cretaceous age met with in England.

Thanks, however, to the labours of Professor O. C. Marsh, of Yale College, Newhaven, Conn., U.S.A., in the remarkable series of Cretaceous lacustrine deposits of the Atlantic coast and the region of the Rocky Mountains, no fewer than thirteen species of bird-remains have been described by that accomplished palæontologist. The most important of these remains are no doubt the *Odontornithes*, or birds with teeth, the first of which, the *Ichthyornis dispar*, was described in 1872. This remarkable bird was, though apparently aquatic in his habits, provided with well-developed wings, constructed upon the usual typical plan of a bird. The jaws were furnished with compressed pointed teeth, fixed in distinct sockets. The vertebræ were bi-concave—a character unknown in the entire class Aves, but common to certain reptiles, amphibia, and fishes.

The other remarkable bird with teeth is the *Hesperornis regalis*, a gigantic diving bird, wonderfully like an existing Diver, or Grebe, but standing between five and six feet high, also from the Cretaceous formations of Kansas. The teeth of this great bird were not implanted in sockets, but in a deep groove extending the whole length of the mandible. The teeth have pointed crowns, covered with enamel, and supported on stout fangs, like the teeth of Mosasauroid reptiles. Externally, the jaw-bones appear to have been covered by a horny bill, as in modern birds, and the extremity of the jaw was without teeth, and covered by a bill. The breast-bone is destitute of a keel, and the wings are quite rudimentary. Its tail is not lizard-like, as in *Archæopteryx*, but consists of about twelve vertebræ, of which the last three or four are amalgamated together to form a flat terminal bone. The tail seems to have been capable of up-and-down movement in a vertical plane, thus probably fitting this organ to serve as a swimming-paddle or rudder, and to aid it in diving. In one of his lectures Professor Huxley has spoken of these large extinct species as follows:—"They differ from all existing birds, and so far resemble reptiles in the one important character that they are provided with teeth; and it is in consequence of this discovery that we are obliged to modify the definition of the classes of birds and reptiles. . . . Before the production of such creatures as these it might have been said that a bird had such and such characteristics, among which was an absence of teeth, but the discovery of a bird that had teeth shows at once that there were ancient birds which in that particular respect approached reptiles more than any existing bird does."

Another remarkable "Ornitholite," as these bird-remains are called, has been discovered recently in the London Clay in the Isle of Sheppey, a marine deposit rich in relics, brought probably from the neighbouring Eocene continent by some great river, whose embouchure was not far distant. This deposit has already yielded remains of *Halcyornis*, a supposed fossil Kingfisher, of *Lithornis*, a small Vulturine bird, of *Dasornis*, a Struthious bird of the size of the living Ostrich, of a small wading-bird, and of a longipennate bird, with wings as large as those of an Albatross. The fossil last found makes us acquainted with a strange saw-billed bird, probably a fish-eating one, like a Merganser, but in which the bony serrations (for they are not true teeth) were of large size, and when covered with a horny sheath must have been formidable organs of prehension. Professor Owen named this remarkable bird *Odontopteryx toliapicus*.

From the Eocene slate rocks of the Canton Glarus, the skeleton, almost entire, of a small Passerine bird, of the size of a Lark, has been obtained, and from the gypsum quarries (Eocene) of Montmartre and Meudon, near Paris, several genera of birds have been described, such as the *Cryptornis* and the *Palæogithalus*, whilst the *Gypsornis* is described as the giant of the family of Rails, being as large as a Stork. Parts of more than one large fossil bird have been obtained from the Miocene deposits of the Sewalik Hills of India, whilst Madagascar has yielded three species of *Æpyornis*, a wingless bird, whose affinities are clearly with the great wingless and extinct Moas (*Dinornis*) of the distant islands of New Zealand, once so abundant even within the period of occupation of those islands by primitive races of mankind. It is quite consistent, however, with what we already know of persistent types, to assume that the wingless birds (of which the *Dinornis*, the *Æpyornis*, the *Apteryx*, the Emu, the Cassowary, the Rhea, and the Ostrich are representatives), have lived on from the Trias

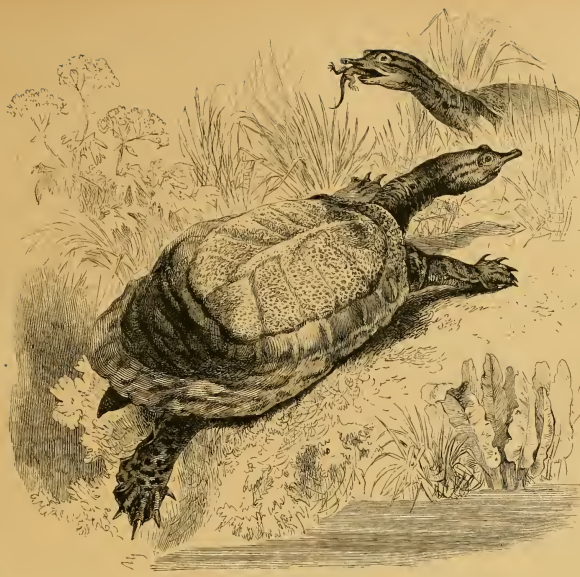
to the present day, having spread over the whole southern world, and in Eocene times passing north even as far as Britain (*Dasornis* from the London Clay was as large as the Ostrich). The fish-eating birds, of which the *Hesperornis* and *Ichthyornis*, as well as the later *Odontopteryx*, are the illustrations, belong to a different type from the existing species, and if *Archæopteryx* is an ancient form of Perching-bird, the same may be said of that too. Within the last few years, in the deposits of the Paris basin, amongst remains of many genera which remain to the present day, have also been discovered relics of Flamingo-like birds, and even of a Roller (*Leptosomus*), a peculiar bird now restricted to Madagascar. Parrots were also represented in the Miocene formations, and a Guinea-fowl (*Numida*) has been discovered in the Post Pliocene deposits near Salzburg, as well as *Necrornis*, a defunct kind of Touraco from the bone-beds of Samson in Gascony.

In the recent deposits of the Mascarene Islands, the remains of the extinct "Dodo," "Solitaire," (*Aphanapteryx*), the latter being a gigantic flightless Rail with a long bill, Parrots, &c., mark the representations of the terrestrial fauna of a once extensive continent, now submerged, save the islands of Mauritius, Rodriguez, and Bourbon. In New Zealand, again, we have the Moas, the giant Gallinule (*Notornis mantelli*), a species perhaps not yet quite extinct, the extinct Flightless Goose (*Cnemiornis*), and an enormous bird of prey (*Harpagornis*), large enough to have preyed upon the Moas.

To conclude, let us ask this serious question:—Are the people of this and other countries doing their duty as regards the birds that live side by side with them? Within the last two hundred years many of the species mentioned in the present chapter were yet alive—the Dodo, the Solitaire, and no doubt the Moa—for in the British Museum are some feathers in a chief's weapon brought from New Zealand by Captain Cook, which could scarcely have belonged to any other bird but the *Dinornis*. It is by the hand of man, and principally of *civilised* man, that these interesting birds have been exterminated. "These lost species," writes Professor Alfred Newton, "there is some ground for believing were mainly, if not wholly, peculiar to the locality, and after having made good their existence, maybe for ages, fell easy and helpless victims to the forces which European civilisation brought into play. Chief among these forces was fire. In all countries and at all times it has been the habit of colonists to burn the woods surrounding their settlements, partly to clear the ground for future crops, and partly (in tropical climates especially) to promote the salubrity of their stations. When fire was set to the forest and bush of a small island, the whole of which could be burnt at once, the disastrous effect on its fauna can easily be conceived. Even the animals which happened to escape the conflagration itself would speedily starve, owing to the at least temporary destruction of the native flora whence, either directly or indirectly, they derived their wonted sustenance." And to these causes of destruction man now adds arms of precision, so that large game of all kinds fall to his gun or his rifle, or, retiring gradually before him, their original habitat knows them no more, and they ultimately die out. Nor is the fair sex above censure. For whose adornment are the beautiful Humming-birds of South America sacrificed in such countless thousands, so that their little bodies now form a staple article of trade to Europe, along with the lovely Rollers, Glossy Starlings, and Bee-eaters of Africa, and the brilliant Impeyan Pheasant of the Himalayas? Sure extinction awaits these birds, if not in our generation, at least in the next, for if the species can save themselves to a small extent by their wings, as the Dodo could not do, and the Apteryx cannot now, the firearms of the hunter more than counterbalance the advantages possessed by the hapless birds he pursues. Stronger measures than a "close time" for birds during breeding-season are needed, to contend against the persecution which attends them for the rest of the year; and nothing but the exercise of common sense and humanity on the part of men and women in civilised Europe can save many a beautiful bird from extermination. It is to be regretted that a fashion should prevail with even the most highly-educated of the fair sex, which has long been banished amongst men, excepting those of the most savage tribes. That the women of Great Britain may be the first to abandon the practice of decorating their wearing apparel with feathers and wings of birds, a fashion which causes immense slaughter in many countries, is the sincere wish of the writer.

R. Bowdler Sharpe.

[Note.—Since this article was printed, a new specimen of *Archæopteryx* has been examined: its zoological position amongst the Birds is open to doubt.—Editor.]



SOFT-SHELLED TRIONYX.

CLASS REPTILIA.—THE REPTILES.

CHAPTER I.

THE CHELONIANS.

General Characters of Reptiles popularly so-called—Divided into Reptilia and Amphibia—THE BUCKLERED REPTILES—The Four Divisions—The Buckler of the Chelonians—The Carapace—The Plastron—Different kinds of Shells—"Tortoiseshell"—Protecting Bucklers—Feet—Shoulder-blade and Arm-joint—The Humerus (foot note)—Appearance of Tortoise's Head—The Process of Eating—Skull—Mouth and Jaw—Eye—Ear—Tongue—How Chelonians Breathe—Their Lungs and Heart—Digestive Organs—The Eggs—Extraordinary Vitality of Chelonians—Brain—THE TORTOISES, THE LAND CHELONIANS—Characters—THE GREAT LAND TORTOISES—Mr. Darwin's Visit to the Galapagos Islands—Enormous Size and Weight of the Tortoises—Probable Extinction—Distinctive Features—Habits—Great Tortoises at the Water-springs—Tortoises of the Mascarene and Aldabra Islands—Indian Tortoises—The Common or Greek Tortoise—African and American Species—THE EMYDES, THE RIVER, OR MARSH TORTOISES—Characters—The Terrapins—The American Box Tortoise—Habits—The Genus Emys—*Emys europæa*—The Painted Emys—*Clemmys insculpta*—The Caspian Terrapin—The Snapping Turtle—The Chelodines—The Matamata—The Snake-necked Tortoises—The "Aiyussa" Tortoise—THE TRIONYCIDES, THE MUD, OR SOFT TORTOISES—Characters—Habits—The Soft-shelled Tortoise—The Cryptopus—The Egyptian Trionyx—The Gangetic Trionyx—THE CHELONIADES, THE MARINE CHELONIANS, THE TURTLES—The Green Turtle—Habits—Size—Food—Egg-laying—How they are Caught—Characters—The Hawk's-bill Turtle—Why so Named—How the Tortoiseshell is Obtained—The Logger-headed Turtles—The Leather-back Turtles—The Sphargis—EXTINCT CHELONIANS—Classification of the Order.

WHEN a Tortoise, a Lizard, a Snake, a Crocodile, a Newt, and a Frog are seen together alive in a zoological garden, or stuffed in a museum, there is not the least difficulty in deciding that they, one and all, ought to belong to a particular group of the animal kingdom, and that they differ from all the other animals called beasts, birds, and fish. Whether they be alive or dead, they convey a

repulsive feeling to the mind, which is not felt on examining any other animal. In confinement, the general stillness of most, and the slow crawling motions of some of these creatures, stamp the whole with the title of creeping things, or reptiles. And when they are in their natural homes, where some display an activity of a singular and occasionally rapid kind, the word creeping is so very generally true to nature that the term reptile really does convey the difference between them and the other vertebrated animals. No one can confound any of these creatures with any of the Mammalia. Most observers of birds would object to their pets being compared with a reptile, and would say that, although the claws and scaly legs of many a bird are not without resemblance to those of the crawling things, there can be no satisfactory comparison between them and the feathered tribes. There is no difficulty in distinguishing between most fish and the reptiles.

Common experience, then, without troubling itself about the insides of the creatures, has separated those whose names were mentioned at the commencement of this chapter from the other animals with vertebræ or back-bones. Beasts, birds, fishes, and reptiles used to be the great divisions of the Vertebrata.

A visit to a collection of living or dead reptiles impresses one with the great number of kinds there are of them, and how very varied are their shapes and peculiar gifts. Some have limbs, others have not; some have a skin, most are scaled, and a few have a regular armour. They live on land and in fresh and salt water, and some indulge in a kind of flight. Some begin life in the water, and end it on dry land. If they are really to be divided from the other Vertebrata, it must be acknowledged that there are greater differences amongst them in shape and in method of life than there are in any of the other classes already noticed.

Very early in the history of comparative anatomy it was shown that the reptiles, popularly so-called, were cold-blooded, like fish, and that it was necessary, principally from the method of life in their youth, or on account of the changes which occur in the anatomy and physiology of their breathing apparatus during their growth, to separate them into two groups: the reptiles, to which belong the Tortoises, Crocodiles, Lizards, and Serpents; and the Amphibia, which in many instances lead at some time of their existence an aquatic life, and which may have tails, like Newts (*Tritons*), or which begin life with a tail, and lose it during growth, like the Frogs and Toads.

The Reptilia, or Reptiles, are cold-blooded animals, with back-bones, which have a scaly or bony-plated skin, which breathe by lungs, and whose heart has the ventricles not completely separated. They have a single occipital condyle to the back of the head, and they may lay eggs or produce living young. The existing reptiles are divided into several orders, some of which were represented in the ages of the past. They are the Chelonians, or Tortoises; Crocodilia, or Crocodiles; Saurians, or Lizards; Ophidia, or Snakes.*

ORDER CHELONIA.—THE BUCKLERED REPTILES.

Tortoises, Terrapins, and Turtles are familiar objects of natural history, and belong to an order of the reptiles called Chelonia.† These Chelonians are cold-blooded, four-footed reptiles, protected by a case, buckler, or shell, and without teeth in their jaws, and they are thus distinguished from all other animals. They usually lead monotonous lives, are numerous in individuals, and there are many genera and families of them. They are divided into four great divisions, and they frequent land, fresh water, and the sea. They have a great and remarkable geographical distribution, which, in some instances, is very suggestive to the geologist and physical geographer, and one group (the Turtles) is of commercial and gastronomic importance.

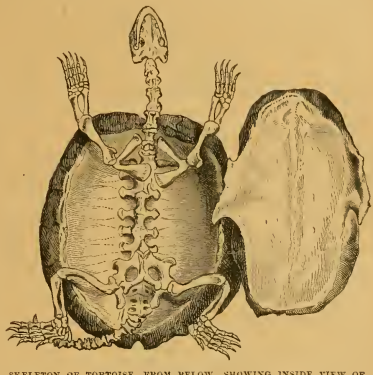
As there are Land Tortoises, Fresh-water Chelonians, mud-loving-ones, and Sea Turtles, the

* This multiplicity of great divisions indicates that there is very great variety in the reptilian class of structure and habits. It is also true that the kinds are very numerous, and that the genera are abundant. Many of the reptiles are never observed by experienced naturalists, and it may be said with great truth that the knowledge of the habits of the group is not so advanced as the knowledge of their anatomy. The classification of some of the genera is in dire confusion, the localities whence some important kinds come are not decided, and unfortunately it is too true that the life history of many is quite unknown. In the necessarily restricted space allotted to the reptiles in a work on natural history, which does not deal with advanced anatomy or elaborate classification, it is only possible to describe and notice well-known or typical kinds; and in doing this the works of Cuvier, Owen, Günther, Dr. Andrew Smith, Coues, Bell, Rymer Jones, Gray, and Huxley, have been freely quoted, and often to the very letter. In making this acknowledgment, it is trusted that the accidental omission, where such occurs, of the names of these distinguished naturalists will be forgiven.

† Chelonia, Tortoise.

order may be divided into corresponding families, under the separate titles of Testudines, Emydes, Trionycides, and Cheloniades. The difference of shape and construction of the members of these "families" is clearly connected with their diverse methods of living. The kinds of some families swim freely; those of others swim and walk, or walk without being able to swim. Moreover, there is a connection between their habits and the food, some being carnivorous, others enjoying a mixed diet, and the rest being vegetarians. All lay eggs, and leave them to Dame Nature's care, and hibernation is common in all except the marine kinds.

The buckler of the Chelonians consists of a deeply-seated bony framework, the top of which, situated on the back of the animal, is called the *carapace*, and the underneath, placed below the body, is termed the *plastron*, or by some the *sternum*. There is in many Chelonians a shell which covers these parts, and is ornamented; and in one species this shell is the "tortoiseshell" of commerce. In others, however, it is not found, and its place is occupied by skin. Curious as these protecting bucklers are, they are still formed by structures which can be traced in most vertebrate animals, but which have been modified to suit the requirements of the Chelonians. The carapace on the top of the Chelonian is a modification of the bones of the vertebral column and ribs, and also consists of bony plates which, growing in the skin, unite all together.



SKELETON OF TORTOISE, FROM BELOW, SHOWING INSIDE VIEW OF CARAPACE AND PLASTRON.

The spinous processes of the dorsal vertebræ and their ribs enter into the composition of the framework of the carapace, and a certain number of single and of paired pieces of dermal bones complete it. These dermal bones are called complementary plates, and single ones may be in the neck, in the middle line, or behind in the sacral region, whilst there are twenty-two plates on the sides, eleven being on each side. These accessory skin bones are called respectively *cervical*, *sacral*, or *pygal*, and *marginal* plates.

A careful examination of the inside of a carapace shows that the spinous processes of the second to the eighth dorsal vertebræ are flattened out, so as to form the middle of the buckler and compose the *median* plates. Then it appears that the ribs of these same vertebræ, and of the ninth also, are enlarged above so as to form eight long flat plates (*costal*), which are united with those in front and behind by toothed joints or interlocking sutures.

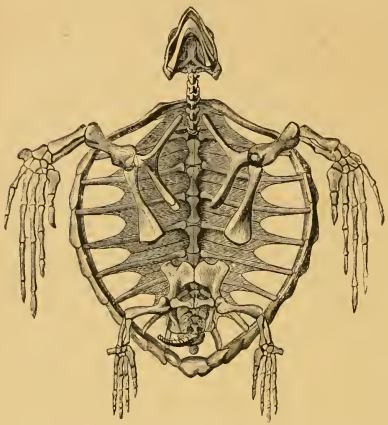
The expanded ribs also unite with the median plates, formed by the expanded spinous processes; and a portion of each rib may be seen underneath the plate-like part and projecting beyond it at the side of the carapace, and its outer or free end is received into a pit in one of the *marginal* plates.

But as the expansion of the rib passes to the spinous process to form part of the carapace, it is separated from the narrower part of the rib, which comes as usual from the side of the vertebræ. A space thus exists between the ribs and their expansions, and it contains the muscles of the back.

The under view of the carapace shows the bones of the dorsal vertebræ, which enter into its composition in the middle line; and on each side are the ribs, with their expanded portions filling up the spaces between them. A transverse section of the carapace shows that the breadth is greater than the height, as a rule, and that an upper arch is formed by the ribs and their expansions, and the expanded spinous processes of the vertebræ form the key-stone. The sides of the plastron are seen as curved lines; and at the sides is a marginal plate, connecting the plastron and rib.

A view of the carapace from above, when the ornamental part of the shell is removed, shows a row of expanded spinous processes in the middle line, flanked by the expanded costal plates which cover in the greater part of the carapace. At the edges of each of these is a projection narrower than they are, and it is the outward continuation of the rib. The ends of the ribs are fixed into a rim of marginal plates. There is a broad plate in the middle line (the nuchal) in front, connected on each side with the front marginal plate; and in some kinds, behind, there is a pygal plate in the middle line, and, like the nuchal, it is attached to the series of expanded spinous processes.

The under part of the buckler, or "the plastron," is not an outside development of the breast-bone or sternum, but is formed exclusively by skin or dermal bones, and usually consists of nine pieces or plates, more or less developed. Of these, one piece is in front, and there are four pieces on each side, between which there may or may not be a middle space, which is closed by skin or by cartilage.



SKELETON AND CARAPACE OF THE LOGGER-HEADED TURTLE, FROM BELOW.

These different plates have received names which formerly were derived from the belief that this bone expansion was a breast-bone or sternum modified. Now it being believed that these bony pieces are all ossifications of the skin, or are what is called *membrane bones*, the names are different, and relate to the word plastron and their relative position.

It has been noticed that the spaces left between the plates of the plastron are filled up with cartilage in some Chelonians, and with skin in others; and it is readily observed that in the carapace of the Green Turtle, which has been taken as the example of Chelonian upper armour, the vacant spaces between the ribs and the marginal plates are also closed by cartilages.

Some of the Chelonians have enormous shells, and in others they are small in relation to the size of the body; in some the texture of carapace and plastron is all bony, and in others it is gristly or cartilaginous, or bony, with a softer margin. The shells of some are flat, as in the Turtles; in others, as in the great Tortoises, the carapace is high and arched. Many Chelonians cannot retire the head, tail, and limbs within the protection of their shells, and others can do this perfectly. Most have the upper and lower parts of their more or less protecting cases soldered together at the edges, but in some there is only a cartilaginous or gristly union; and whilst in the majority the carapace and plastron are immovable in themselves, in some there is an amount of mobility in the plastron, by its having one or more unossified and cartilaginous parts stretching across from one side to the other.

The carapace and plastron may be beautified by an outside covering, the "tortoiseshell," which differs greatly in its kind and ornamentation in the various groups into which the Chelonia are divisible. In many the well-known "tortoiseshell" covers over all the hind parts, and in some only a portion of the protecting case is thus ornamented. There are some Chelonians with a covering resembling leathern skins, and others have the plastron covered with soft skin. The "tortoiseshell," which is the ornamental horny covering to the carapace and plastron, and out of which hair-combs, knife-handles, and inlaid work are made, is to all intents and purposes an outside or scarf-skin

structure belonging to the epidermis. It is in the form of thin plates, which are united together at their edges, and which correspond, to a certain extent only, with the underlying bones of the shell. The number, size, and position of these plates differ in all the great groups which possess them, and even in the genera and species, and so do their colours and ornamentation. In most there is a very geometrical configuration to the plates and to their grouping: and as large pieces of the epidermoid covering, or "tortoiseshell," are the best, those of the Hawk's-bill Turtle are the most in request. Usually, the position of the tortoiseshell plates is impressed on the carapace and plastron beneath them, the edges being recognised as indentations.

The breast-bone, or sternum, which is so well seen in Birds and Mammals, does not exist in the Chelonia, neither are there any sternal ribs; moreover, the vertebræ which enter into the composition of the carapace have no transverse processes. Only the ribs are present at the sides, and they arise between the body of the vertebræ and their neural arch, which is capped by the expanded spinous process.

SKELETON OF TORTOISE, FROM ONE SIDE.

Consolidated and comparatively motionless as are the bones and plates of the carapace and plastron, this is not the character of the rest of the skeleton, for the neck, tail, and limbs can be active enough, and their anatomy is in accordance with their mobility.

A remarkable little Tortoise* has a long plastron, which can be bent across just behind the first quarter of its length, and it is broad and very close behind. There are openings for the head and neck, and for the four limbs, so that the armour is very complete. When the animal is alarmed, and withdraws its head and fore-limbs under the carapace, the movable front part of the plastron closes over their openings and effectually covers them; and when it desires to move again, the trap-door is opened by being lowered, and the head and fore-limbs can come forth. Another Tortoise,† belonging to the same great group of Land Tortoises as that just mentioned, has the carapace movable behind, but not the plastron in front, and the animal protects its tail and hind-limbs effectually by bending it down. But this protection does not take place through the agency of an elastic ligament, as in the Pyxis Tortoise, allowing the plastron to be bent. On the contrary, the plastron does not move, but the vertebræ, ribs, and plates of the hinder part of the carapace are not rigid, and can be bent down and curved by muscular action, so as to shut up the posterior openings, by approaching the back surface of the plastron. This last is rounded behind, and in its general construction it differs somewhat from that of these so-called Box Tortoises. One of the most perfectly protected Chelonians, although it belongs to a soft-skinned group called Mud or Soft Tortoises, has three holes in the back part of the united buckler. Amongst the Chelonians with incompletely protecting bucklers are the Turtles, for vast as their shields may be, still their head and limbs cannot be brought within them as in the Tortoises. Still greater want of covering is noticed in the Alligator Terrapin‡ of North America, and in the great-headed Platysternon of China.§

The feet are not heeled in the Chelonia, so that they have a hand-like look, and the ankle-joint beneath the tibia and fibula has only one bone, in contact with it in some kinds, and two in others. Four other bones are present in the Tortoise, which has five small toes, the little toe projecting from a metatarsal bone that sticks out from the foot. There is a good amount of fleshy padding under the fingers and toes in some kinds, and a web exists between them in others. The swollen appearance of the under part of the feet of the Tortoise is remarked by every young naturalist who has kept them as pets, and the nails are attached to the very short digits which seem like little excrescences. But other Chelonians, such as the marine and the fresh-water kinds, have well-developed fingers and toes, with webs and nails. The Turtles especially move with great grace, the hands and feet taking on a "feathering" motion, like paddles.

* *Pyxis arachnoides.* † *Kinixys homeana.* ‡ *Chelydra serpentina.* § *Platysternon megacephalum.*

One of the peculiarities of the Chelonians is that instead of their shoulder-blade and joint for the arms being *outside* and upon the ribs, as they are in every other group of things possessing ribs and arms, they are *beneath the ribs* and *inside* the body. They are under the carapace, which is made up of altered ribs. The shoulder-girdle, of which the shoulder-blade forms, as in the Birds, a very important part, has a coracoid bone of great relative size, and there is a third large bone connected with the scapula, which is called the acromion process. The girdle is a three-branched structure, and the cavity (glenoid) for the joint of the upper arm-bone is composed of a part of the scapula and part of the coracoid. There is no collar-bone, and as there is no breast-bone or sternum, the shoulder-girdle is hung, as it were, underneath the bodies of the vertebræ. The scapula, which is a cylindrical bone, is directed upwards in the proper position of the animal, and is hung to the body of the second vertebra of the carapace by a ligament. The coracoid is flat and more or less triangular, and is directed backwards in the body.* There is nothing like this tripartite incomplete girdle in any other order or class of the Vertebrata.

SCAPULAR APPARATUS OF TORTOISE.
s, Scapula; *a*, Acromion Process; *c*, Coracoid Process.

In the early stage of the existence of the Chelonia the girdle is not within the ribs, but in front and outside of them, but during growth the permanent position gradually prevails. This remark applies also to the pelvic bones and part of the thighs, for they, instead of being behind the ribs, are beneath and inside them in adults.

Everybody who has kept Tortoises, or who has had the opportunity of watching them in a zoological garden, must be struck with the shape of the head as it is slowly put forth from beneath its protecting shell. Its expressionless face, with its large nose-openings, meaningless eyes, and toothless, lipless jaws, is as remarkable as the apparently large brain-case, which is broad behind and very solid-looking. There is no external ear, but there is a tympanic membrane, which is visible in some kinds.

HEAD OF TURTLE.

To see one of these sedate creatures eating does not give the impression that it is an easy or enjoyable proceeding. The piece of cabbage or other leaf is grasped in the wide gape of the jaws, which have a horny plate instead of teeth, and the motion of the lower jaw is simply up and down. The head is projected at each bite, and gradually the morsel is forced down the throat. It is evident, however, that although the creature is very slow in its movements it has very good eyes, and that it can detect its favourite food at once. Roaming about slowly, in search of food, the Tortoise turns its head but little to the right or left; nevertheless, it has the back of the skull well suited for movement, for there is a single condyle, as in the Birds, by which it articulates with the first bone of the vertebral column.

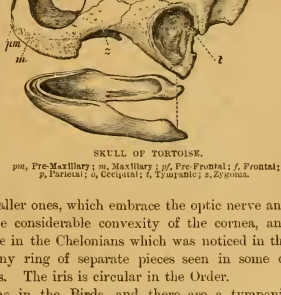
On comparing the bones of this skull with those of the other classes, it is found that there are no nasal bones present, and that they are replaced by additions to the frontal bones, in the form of two pre-frontals. The parietal bones are largely developed, and are prolonged downwards as thin plates to the bone forming part of the front of the base of the skull or the basi-sphenoid. This prolongation occupies the place of the wing of the sphenoid bone (ali-sphenoid) in Birds. The pre-maxillæ are small and are usually united, and the vomer is single and forms a plate below on the

* The bones of the fore-arm joint with a humerus which is remarkable for its shape, which is adapted to support the weight of the body whilst the fore-limb is in movement. When compared with the corresponding bone of a mammal it appears to be out of its axis. The body of the bone is bent, the head of it is very rounded, and there are two knobs or tuberosities near it. One of these is located behind and above and the other is placed inwards and backwards. In the higher animals their position is internal and external, so that the Tortoise's humerus has, as it were, a twist. The lower part of the bone is wide and flat from before backwards, and there is a furrow along the outer border which is especially developed in the marine Chelonians, but less so in the fresh-water kinds, and least in the Tortoises. The marine Chelonians have not the bent condition of the humerus noticed in the land kinds, and the difference relates to their very different mode of life.

hard palate, and joins the palatine bone on each side, to form a very solid piece, behind which is the opening of the inner nostril. There is a post-frontal bone, which, with the squamosal of the ear-bone, occupies the upper part of the temporal region, and the last-named bone is placed at the side of the ear-capsule and above the quadrate bone. The pterygoid bones of the base of the skull and hard palate are behind the nostril, and are united together, and with the quadrate bones also. There is no transverse bone.

All these bones, most of which, but not all, are comparable with those of the Birds, are united together immovably, and the solidity of the skull is great. In the Turtles, and in some of the Terrapins, there is a false roof to the skull, produced by a flattening of the parietal ridge and its union in front with the post-frontal bones and behind with the squamosal. It is this which gives the large and solid appearance to the head. The skulls are nearly all face and outside, and the brain-cavity is very small.

On examining the mouth of the Tortoise a sharp edge of horn is felt; and it is noticed that the mandible is very solid, and that it unites with the head-bones far back, and after the fashion of the Bird rather than of the Mammal. There are traces of all the different bones which make up the lower jaw, on each side, in the Birds, to be found in the Chelonia, but they all become solidly united at an early age. In the Tortoises there is union at the chin, and the dentary bone resembles that of the Bird, but the Matamata of North Brazil is said to have the front bones of the lower jaw separate.



SKULL OF TORTOISE.
pm, Pre-Maxillary; *m*, Maxillary; *pf*, Pre-Frontal; *f*, Frontal; *p*, Parietal; *o*, Occipital; *t*, Tympanic; *z*, Zygoma.

The jaw-joint, which moves on the skull on each side, is fitted into a wide and large quadrate bone, which is fixed to the skull, the mammalian method of articulation not being seen, but that of the Bird being closely followed. Teeth are absent in the group, but in some kinds the horny substance of the jaws is irregular and saw-like, and the front may be produced into a kind of beak.

Sight is evidently keen in most Chelonians, and the eye is a very elaborate organ, provided with eyelids, a nictitating membrane, and well-developed tear glands. There is much perfection of the movement of the eye-ball, and there are six powerful muscles, and four smaller ones, which embrace the optic nerve and are expanded over the ball behind. There is the same considerable convexity of the cornea, and the smaller convexity of the rest of the front of the eye in the Chelonians which was noticed in the Birds, and singularly enough the plates forming a bony ring of separate pieces seen in some of these last are present generally in some of the Chelonians. The iris is circular in the Order.

The internal ear has the same important parts as in the Birds, and there are a tympanic cavity, a rudimentary cochlea, and three semicircular canals. The Eustachian tube of the higher animals is represented, and particles of a calcareous nature, called otoliths, are found in the sac-like cochlea. The vibrations of the tympanic membrane, which is visible at the side of the skull, are transmitted to the internal ear by one little ossicle instead of by three, as in the Mammalia. It is said that some of the gigantic Tortoises are deaf.

The sense of taste must be reduced to the utmost in the Chelonia, and the tongue is covered with a thick rugged membrane, smooth in the Turtles, but beset with pointed papillæ in the Great Tortoises. A number of glands exist beneath the membrane, and supply the mouth with a moistening secretion, and the tongue is supported by a hyoid bone, which is cartilaginous, and sends a little bone into the centre of its substance—the lingual bone.

The hyoid bone is of great importance in the Chelonians, for it not only has to do with the tongue, but it also assists materially in the mechanism of breathing. Mammals and Birds breathe by having air drawn into their lungs by means of the expansion of their ribs and the movement of their chest by muscles, and by expelling it through the reverse movements, and by the elasticity of the lung itself. Now, Chelonians have no movable ribs, and the muscles are either wanting or are

positively within the chest. Watch the land or water Chelonians, and they seem never to breathe; it is only when these last have been under water for some time that bubbles come up from their mouths. There is no vigorous chest movement resembling respiration. In fact, the Chelonian lungs have air forced into them by a process not unlike that of swallowing. Keep a Tortoise's mouth open too long, and it will be suffocated for want of air, or close the nostrils, leaving the mouth free, and the same result will follow. The Chelonians breathe by keeping the mouth firmly closed, and by the action of certain muscles in the throat, some of which pull down the hyoid bone and the bone of the tongue, and others which restore it to the usual position. The hyoid bone being dragged down, air rushes in at the nostril, gets into the mouth, and then the tongue closes the internal nostril, whose position is at the back of the palate. Then, as the bone and tongue are moved upwards again, the air is forced down into the lungs, and the air-cells are filled. The expiration of the air is produced by the collapsing of the air-cells, and it passes slowly upwards through the main air-tube to the mouth. The breathing is very slow. In the Chelonians, and all Reptilia, the midriff muscle is absent, the chest and abdominal cavities being continuous, and all the viscera are covered with a membrane, called pleuro-peritoneal.

The lungs of the Chelonia are large and occupy much space; in some, as in the Alligator Terrapin, they are divided into several compartments, and the air-cells and the breathing-surface generally appear to be the most complicated near the entrance of the main air-tube. Like those of all Reptiles, the lungs of the Chelonians contain cold blood, and the chemical and physiological changes in it are incomplete and slow. No brilliant red stream is passed from the lungs to the heart in the Reptiles, for the blood therein flowing is dark—a mixture of oxygenised and imperfectly aërated blood—and it is sent forth in that state by the ventricle of the heart all over the body and into the lungs. The auricles of the heart, which are very capacious in the Chelonia, are situated above and before the ventricle, and are divided by a partition. The ventricle—for there is only one—is muscular, and the blood rushes from the two auricles into it and gradually distends it. In the Common Tortoise the ventricle is little more than a simple cavity, but in the Hawk's-bill Turtle the cavity is divided into several communicating compartments by muscular projections and fibres, which strengthen the whole. But in both and all other instances the ventricle, by its contraction, expels the blood, not into the auricles again, but through a series of blood-vessels, namely, two distinct aortæ, a right and a left, and a main vessel for the lungs or pulmonary artery. The blood of the great veins is thus mixed in the ventricle with that from the lungs, and the mixture of oxygenated and non-aërated blood is sent forth, some of it to the body, and some to the lungs. The two aortæ pass backwards and unite opposite the fifth dorsal vertebra, and thence but one vessel is continued to supply the body.

SECTION OF LUNGS OF TORTOISE, SHOWING CELLULAR ARRANGEMENT.

Besides the system of veins and arteries, the Chelonians, as well as all Reptiles, possess large sets of lymphatics, and they open into the great veins of the neck on each side.

The blood corpuscles of the Chelonia, and of all Reptiles, are elliptical in shape, and are larger than those of the Birds and Mammalia; probably those of the Tortoise are $\frac{1}{130}$ of a line long and $\frac{1}{1650}$ of a line broad. And experiment has shown that the temperature of the blood and of the animal is very slightly above that of the air or water in which it may be placed for a while.

Although some Chelonians can last without food for many months, others feed constantly; and whilst some enjoy vegetable substances others are carnivorous. Hence there is some diversity in the structure of the digestive organs; but it is only necessary to state that the flesh- and insect-eating kinds have a shorter intestine than the others. In all there is a capacious gullet and œsophagus, but there is no crop. The muscular coat of this passage is strong, and in the Turtles the inner surface is lined with long, hard projections pointing towards the stomach, denying return to anything which has gone down. The stomach is long, thick, cylindrical, and bent; its walls are very muscular, and it is closely connected with the liver, that of an American fresh-water kind (*Emys concinna*) being imbedded in it.

GREAT LAND TORTOISES.

(*From the Living Specimens in the Zoological Gardens, London.*)

Laying eggs, the Chelonia have them of a calcareous nature outside in the Land Tortoises and fresh-water kinds; but the Turtle's eggs are leathery, or like parchment to the touch. The construction of the egg-producing organ greatly resembles that of Birds; and it is only necessary to state that the internal structure of the egg and the development of the young in its early stage differ in no very essential circumstances from those of the Bird. The carapace and plastron appear before the egg is broken by the outcoming Chelonian.

There is a wonderful amount of vitality in the Chelonians, and, indeed, in many other Reptiles. Some can live for many months, and it is said years, without food, and it is well known that movements and indications of life remain for a considerable time after the head has been removed from the body or the brain from the head. Their lives are very much the same year after year and generation after generation; their passions are cold-blooded, and there are no permanent displays of the affections. Hence the brain and spinal nervous system are less developed than in Birds, and they are small for the size of the head and body. The surface of the rather long brain is smooth, and there is a projection in front—the olfactory lobe—which is hollow; the optic tubercles are rounded, and are separated by a deep fissure; the cerebellum is nearly hemispherical, and the fourth ventricle is well developed. Finally, the sympathetic or organic system is feebly developed in the Chelonia.

FAMILY I.—THE TORTOISES.—THE LAND CHELONIANS.*

These have the carapace and plastron bony, and covered with shelly plates, and the buckler as a whole is swollen above. They can retract the head, neck, and extremities within its covering, and they live on land.

BRAIN OF CHELONIAN.

ol, Olfactory Lobes; *c*, Cerebrum; *op*, Optic Lobes; *cr*, Cerebellum; *sc*, Spinal Cord.

THE GREAT LAND TORTOISES.

When Mr. Darwin visited the Galapagos Islands, he saw the relics, as it were, of a family of huge Tortoises, which lived there in abundance a few years before, and was able to verify many interesting facts which had been recorded by Porter, in his "Journal of a Cruise Made to the Pacific Ocean in 1813." Porter noticed the deafness of the huge creatures, and, like former voyagers, was impressed with their enormous size, with the long necks of some, and with their quick sight and ponderous movement. He stated that some of the Tortoises captured by him weighed from 300 lbs. to 400 lbs., and that on one island they were five feet and a half long, four feet and a half wide, and three feet thick in the body. They walked with the body about a foot from the ground, and the females seemed to preponderate. It is quite evident from Porter's narrative that several kinds lived in the islands, those of one island differing from those of another, but all being of the same group of Tortoises. He expatiates on the luscious and delicate food that the long-necked and small-headed and other kinds supply, and notices their ability to last long without food. After Mr. Darwin's visit the progress of extirpation went on, and in eleven years Mr. Seeman, naturalist on board H.M.S. *Herald*, found that on one island there were no longer any Tortoises, and that everywhere they had diminished in number. At the present time it is most probable that the gigantic Tortoises are very rare where they were formerly so abundant. There were five species there a few years since.

These Galapagos Tortoises were of several kinds, each inhabiting especial islands in the Archipelago, and they can be recognised in museums and in the few living specimens which have been brought to Europe by the black colour of the shell, the thin condition of the bony carapace, the general lightness of the huge buckler, and by the usual front plate being absent, so that their long neck can be raised up, carrying the head above the level of the body. The legs are long, and there is a remarkable plate or scale on the inner side of the elbow.

They have flat-looking and small heads, and usually there is a very decided crest of bone at the top and back of the skull. Dr. Günther described four important species of this group, and states that in James Island, *Testudo elephantopus* and *Testudo nigrita* were the only kinds, and perhaps only the first-named; and he has evidence to prove that King Charles Island was inhabited by *Testudo ephippium*,

* *Testudines.*

and Hood's Island by *Testudo microphyes*. The first of these Tortoises has been known to have a carapace three feet in length and forty inches in breadth over the top. The limbs are large and long, and the feet huge; moreover, the erect neck allows the head to be moved here and there, to use Dr. Günther's expression, in a manner not unlike that of the Cobra di capello. The bones of the wrist and the fingers are broad and short, the scaphoid and intermedium being united, and the whole is elephantine in its proportions. *Testudo nigrita* had a nearly circular carapace as large as that of its fellow.

Moseley states that some of these Tortoises were on board the *Challenger*, and were fed on pine-apples, a number of which were hung in the paymaster's office. The animals used to prop themselves up against a board put across the door to keep out dogs, and unable to surmount the obstacle, used to glare and sniff longingly at the fruit. They, moreover, used to make their way along the deck to the captain's own cabin, where there was a store of the same fruit.

The Great Tortoises are very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated towards the central parts, and at a considerable elevation. Near the springs it was a curious spectacle to behold many of these great monsters; one set eagerly travelling onwards with outstretched necks, and another set returning, after having drunk their fill. When the Tortoise arrives at the spring, quite regardless of any spectator, it buries its head in the water above its eyes, and greedily swallows great mouthfuls, at the rate of about ten in a minute. The inhabitants say that each animal stays three or four days in the neighbourhood of the water, and then returns to the lower country; but they differed in their accounts respecting the frequency of these visits. The animal probably regulates them according to the nature of the food which it has consumed. It is, however, certain that Tortoises can subsist even on those islands where there is no other water than what falls during a few rainy days in the year.—(*Charles Darwin*).

One of these Great Tortoises* is that of Abingdon Island, in the Galapagos Archipelago, and there is a fine specimen stuffed in the British Museum. It has a very long neck, a small flat-topped head with a short snout, and the front of the jaws is straight up and down. It had originally the weight of 201 lbs., and, like the others, is sought for on account of the oil it contains.

None of these huge Tortoises are known on the mainland of America, which is the nearest continent, and it is a remarkable and most suggestive discovery that their nearest allies in size and structure formerly lived thousands of miles away across the great Pacific Ocean, in the Mascarene Islands, the Island of Rodriguez, and also in the Island of Aldabra, to the north-west of Madagascar.

The Great Tortoise from Aldabra, specimens of which have been taken to the Seychelles and acclimatised, is round-headed, and has a convex skull, and the beak is, as it were, trenchant. The third cervical vertebra is bi-convex. Now the Great Tortoises of the Mascarene Islands, but lately extinct there, although closer geographically to those of Aldabra Island than to those of the remote Galapagos Archipelago, resemble these last more than the others. They have a very thin carapace and a flat head; moreover, their plastron is short. So that although their anatomy closely resembles that of the Galapagos Tortoises their configuration differs.

There is a fine specimen of a huge Tortoise from Aldabra Island, which once weighed 870 lbs., in the British Museum, and it is called *Testudo elephantina*. Before its death (January 29, 1877) it had a home in the Zoological Gardens.

The Tortoises found in India are not of very large size, and number three species; [the so-called Indian Tortoise, which attains a length of four feet, does not come from the mainland, but from Aldabra Island]. One of them is the Elegant, or Starred Tortoise, whose shell is of a black colour with yellow areolæ, with yellow streaks radiating from them, those running towards the corners of the plates becoming gradually wider.† The plates are often humped on the back, and deep cavities exist at those places inside. It attains the length of twelve inches, and is found in many parts of the peninsula of Southern India and Lower Bengal.

Captain T. Hutton states that in some places where these Tortoises are found in hilly tracts and in the high grassy jungles adjoining them, they are not readily procured, because their colours and those of the surrounding rocks are blended. They remain in concealment beneath tufts of grass during the heat of the day, but the Bheels, who are expert in tracing their footsteps, generally succeed in catching them. These Tortoises came out, when in confinement, a little before sunset, to feed on grass, cabbage,

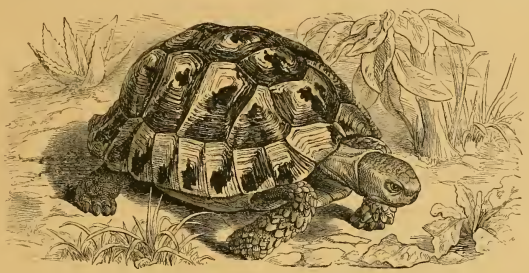
* *Testudo abingdoni*.

† *Testudo elegans* (Schöpff).

or lucerne, and they remained out and quiet during the night, as if enjoying the cool air. They were fond of plunging into water, where they would remain for half an hour, and they drank large quantities by thrusting their heads in and swallowing it by draughts. During the rainy season they were much more lively, and wandered about, and when the laying season commenced, in November, the female moistened some earth at the selected spot, made mud of it, and then scraped it away until a pit was formed. In two hours one had made a hole six inches deep and four inches in diameter, and in this she deposited her eggs, four in number. She filled up the hole, and beat down the mud with the whole weight of her body. They did not burrow when they became quiet in the cold season, but were listless, though not torpid.

The males butt against each other and make much noise, and strive against their adversaries in trials of strength. Sometimes they tilted each other over, and there was great difficulty in getting on the legs again. The next Tortoise is the Afghan Tortoise,* which has four claws in front; and the last, the Burmese Tortoise,† with a long shell and five claws in front, is met with in Camboja, Arakan, and Mergui.

A Tortoise, which is imported into England and sold in considerable numbers, and which is made



COMMON OR GREEK TORTOISE.

a domestic pet, is found in most of the countries bordering on the central and eastern part of the Mediterranean Sea, Greece, Turkey, Asia Minor, Palestine, and Dalmatia. This kind is also found as far north as the Danube, Italy, and the islands of Sardinia and Corsica, and it is said also to live in the Balearic Islands, the South of France, Switzerland, and even farther north. But it is difficult to decide its correct natural limit, for this *Testudo græca*, or Grecian Tortoise, has long been an object of interest and commerce, and may have been introduced into countries beyond its natural position.

Like all the members of the genus Testudo, which is the most important one of the family, this familiar creature has a buckler on top and underneath, which are commonly called the shell, and they are united and solid, having openings in front and behind for the neck, arms, legs, and tail. It is a slow-moving creature, and it withdraws its head and limbs within its buckler on any great alarm, and remains passive and safe until the danger is past. It travels at night as well as by day, and those people who keep one in their garden will generally find that their succulent and nicest vegetables are attractive to it. This Tortoise recognises its kind feeder; but it certainly will try and get out of the way of children, who place it often on its back, and enjoy its curious struggles to return to the proper position. The pet Tortoise disappears in the late autumn, and reappears in the spring, having buried or hidden itself under garden refuse, and having enjoyed a quiet winter's sleep; and they live for many years. They dislike the wet, and evidently seek the shade when the sun is very hot.

* *Testudo horsfieldii* (Gray). † *Testudo elongata* (Blyth).

The peculiarities of the Tortoise were well known to the ancients, and a military machine used in besieging towns was called after it, and the curious story about the death of the tragic poet Æschylus, already noticed in mentioning the habits of the great Lämmergeier, testifies to the acquaintance of the ancients with the solidity of this bucklered reptile.

The Ethiopian region of natural history has the greatest number of species of Tortoises, and the Leopard Tortoise,* the Grooved Tortoise,† and the little Geometric Tortoise‡ are familiar examples. The last Moseley noticed as loving the sandy and arid districts of the Cape of Good Hope, and he states that they may be tracked by the marks they leave on the soil. They are caught, and their little shells are made into paper weights, being first of all filled with lead. The Radiated Tortoise § is from Madagascar. There are no true Tortoises in Australia. The American species, including the Great Tortoises found on the Galapagos Islands, are the Gopher Tortoise from North America and Mexico, and the Brazilian, Black, and Argentine Tortoises from South America.‖ There is a Tortoise in Chili, Northern Patagonia, Mendoza, the Pampas, Monte Video, and Buenos Ayres, which resembles in its colour and general appearance one from the very distant regions of Abyssinia. But this American Chilian Tortoise (*Testudo chilensis*) has a more depressed shell, and the marginal and chest plates differ from those of the African kind.

The Gopher has its most northern limit on the western border of South Carolina, and they are found in Georgia, Alabama, and the Floridas. The adults are strong, and can move a weight of some hundred pounds or more, and in the wild state they seek their food by night. They like dry and sandy places, and are abundant in poor and barren countries. They are fond of the sweet potato, and go into their holes in the heat of the day. They dislike rain, and retreat on a shower commencing. As the cold comes on they hibernate, but a few warm days will restore their activity.

The remaining groups of the Tortoises have already been noticed in explaining the mobility of the plastron and carapace in certain Chelonians. They constitute the genera Pyxis and Kinixys, and may be called the Land Box Tortoises, in contradistinction to some others which lead a more or less aquatic life, and which belong to other divisions of the order.

FAMILY II.—THE EMYDES.—THE RIVER AND MARSH TORTOISES.

These Chelonians lead, with one or two exceptions, a land and water life. Their limbs are slenderer than in the Tortoises, and their digits are united by a web for swimming purposes. As a rule, the carapace is flatter than in the land group, but it is bony, and there is a well-developed horny covering.

The family may be subdivided into two groups. In one the head and fore limbs can be withdrawn under the shell, and in the other the neck is so long and the buckler is so small that the usual shelter is incomplete. Nevertheless, the members of this last group do manage to get their heads under cover of, but not within, the carapace and plastron.

An example of the first group—the Terrapins—which are very common in the United States, is the American Box Tortoise. It is familiarly known as the Carolina Box Tortoise (*Cistudo carolina*), and in other and different localities as the Virginian or Mexican, and from its ornamentation the Ornate, or Chequered Tortoise. This animal has a very wide distribution in the United States and in North America, from Maine to Florida, westward in Texas, Iowa, and Missouri, and in Mexico, and can be recognised among its fellow Emydes by its singularly terrestrial habits. It rarely frequents marshes, and probably never the water, but it is found in dry, hot, pine forests and on mountain ground, looking after beetles, grubs, and, it is said, snakes. The slightly-arched and keeled carapace is about five inches long and four broad, and is broadest behind. It is of a rich brown or brown-black tint, and has yellow spots or stripes. The plastron, movable before and behind, is yellow or brown, and there is the usual hood to the neck, out of which the head peeps and returns, more or less, as within a glove-finger. Many years since Mr. Ord described the habits of one from Pennsylvania, which managed to get its living in rather a parasitical manner. It was found feeding

* *Testudo pardalis.* † *Testudo sulcata.* ‡ *Testudo geometrica.*
§ *Testudo radiata.* ‖ *Testudo polyphemus*, and *Testudo tabulata.*

on the leavings of the Night Heron, and enjoying the little bits of fish which had dropped from the bird's beak, and which the Heron did not consider worth picking up. It prefers its food in a half putrid state, and searches also for insects and worms. Mushrooms, peaches, strawberries, and raspberries are not despised by this omnivorous creature, but this mixture of food renders this edible Terrapin anything but a favourite food, although its flesh is said to be excellent. Like most of its family, this Cistudo hibernates. It seeks a warm loose soil with a southern aspect, often under a heap of decayed brushwood, and digs down beneath the surface in the middle of October. There it lives—unless the weather is very severe, when many die—until the middle or latter end of April, in a torpid condition. It comes forth very feeble, and soon begins to move if the sun is shining warmly. After a while it seeks a soft place, digs down, makes a deepish little hole, and lays an egg, which it covers with a little earth, using the hind feet. Then another is laid and covered up, and at last the laying is finished, and the mother covers all, and treads the ground down so that the nest is found with difficulty. The young when just hatched are soft and cartilaginous.

The genus Emys belongs to this group, and is very rich in species, which inhabit all the temperate and tropical regions, except Australia. They cannot well exist without water, and they abound in the still waters and tanks of the lower parts of India, often remaining motionless on the water, the shell and the snout above it and the rest below, and they disappear at the approach of danger, darting away with great rapidity. Their pointed claws enable them to crawl easily over slippery and steep places, and dig little holes for a small number of long hard-shelled eggs, which in some species are from eighteen to twenty months in hatching. They are chiefly carnivorous, and the flatter the shell, the broader the foot-web, and the more jagged the jaws, the more aquatic and destructive are the habits. They live on tender insects, frogs, small fishes, little birds, and small mammals, and are in turn hunted and eaten by Crocodilia and large fish. They are easily kept in captivity, provided that they are placed in a tank, and fed with meat cut into small pieces or with frogs. The head and feet can be retracted within the carapace.

Of these the Ocellated Pond Tortoise* approaches the Land Tortoises in its habits and in several characters, and has a brownish shell, with "eye" spots of a chestnut-brown with a light edge, and the lower parts are yellow. It comes from Mergui and the Tenasserim coast. China yields the Speckled Emys, about five inches and a half long.† The Thurgi‡ is large, over twenty-two inches in length, and the jaws are denticulate. It is highly carnivorous, and comes from the Ganges. The Yellow-spotted Emys‖ comes from the same river, and has been brought to Europe. Finally, the Ceylonese Pond Tortoise§ is common in Ceylon as well as in the peninsula of Hindostan, and the shell is uniform brown and the plastron brown-black in colour. The Pangshures are confined to the Indian continent, and have the buckler solid and entirely bony. The feet are broadly webbed, and the claws are of moderate size, five in front and four behind. The common one is found in the Ganges and other Bengal rivers. It is known by its elevated back, and the yellow colour and black spots of the lower parts of the shell. The Batagurs have the carapace depressed, and the claws are feeble. One which reaches the length of twenty inches is thoroughly aquatic, and is found in the Ganges and Irawaddy. It abounds in the Hooghly, and is sold for food.¶

The genus Emys has species also in Japan and the Holy Land.

The Chicken Tortoise** of the United States probably belongs to this group, and is dark brown, with a yellow vertebral line. All the plates are marked with yellow lines, and communicate to give a reticulate appearance. The shell is nine inches and a half long. The creature inhabits ponds and stagnant waters, and swims slowly from place to place, the head and neck only being visible. They bask on limbs of trees, and plunge in at the least noise. They inhabit North Carolina, Georgia, and Florida.

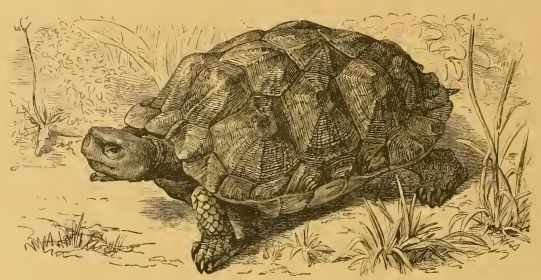
The *Emys europæa*, a great lover of fresh water and marsh land, is to be found in South-eastern Europe, and in Italy, Switzerland, the South of France, Spain, and Algiers. It formerly was not uncommon in the neighbourhood of the Oder, Elbe, and Danube, and it extends into Persia. A small, flat, rather round-bucklered and long-tailed, bright-eyed, yellow-spotted, lively little thing, is this Emys, and it is often sold in England as a pet. It is brown-black on its flat carapace, but the few small yellow spots distinguish it at once. The toes, five in front and four behind, are webbed to a certain degree,

* *Emys ocellatus.* † *Emys bealii* (Gray). ‡ *Emys thurgi.* ‖ *Emys hamiltoni.*
§ *Emys trijuga.* ¶ *Emys tecta* (Gray). ** *Emys reticulata.*

and the claws are sharp. The carapace and plastron are solidly joined, and the first has twelve shell-plates. There are two scales in the arm-pits and two in the region of the groin. These little Emydes are killers and eaters of small fish, beetles, and other insects and worms, but they will occasionally eat bread and vegetables: and to their cost, for when thus nourished they are occasionally made articles of food for man. They like stagnant water, and do not go far from the banks; they hibernate in the winter, and dig down and bury themselves in the mud at that season. It is said that their eggs require a whole year to incubate and hatch. The buckler gets more oval with age, and may reach eight inches in length and five in width.

The Painted Emys (*Emys picta*) is a well-known kind in the Eastern and Middle but not in the Southern United States. It has a broad yellow band, limited by a black line, extending along the front of the scales, and the margin of the carapace has blood-red blotches on it. It has a large web to the feet, and is very aquatic, dying if kept many days out of its favourite element.

Another and allied genus is Clemmys, of which *Clemmys insculpta* is found from Maine to Pennsylvania. It is not always found in and near water, for it is a great wanderer, and makes its way to the forest.



CLEMMYS INSCULPTA.

Another of this widely-spread genus, which is often made to replace that of Emys, is found in Europe and Western Asia. It is the Caspian Terrapin,* with a pale olive back and indistinct paler, yellowish, reticulated lines, edged with black. The plastron and under-side of the margin are black, with irregular-sized yellow spots on the outer side of each sternal shield; the head and neck are olive, and the throat and sides of the neck have black-edged pale streaks. The upper beak-like jaw has a slight acute central notch and a tooth-shaped process on each side.

Another important genus of this group is Kinosternon, in which the fore and aft part of the plastron are movable, after the fashion of Water Box Tortoises. They are popularly called Double-flapped Box Tortoises. The Pennsylvanian Mud Terrapin is the example.†

The well-known Alligator Terrapin,‡ or Snapping Turtle, belongs to the genus Chelydra of this family. It has a comparatively small buckler, but it is provided with a plated head, armed with a hooked beak. The claws are, moreover, strong, and the tail has a crest on it. There are two growths or barbules under the chin. This is an active swimmer, and is very destructive of fish and even young birds. They grow to a considerable size, for some measure twenty-four inches, and the longest attain four feet in length. The weight of 20 lbs. is not uncommon. They are found in stagnant waters or shallow pools, but generally prefer deep water, and live at the bottom of rivers; and when they come to the surface, they elevate the tip of the pointed snout and float along with the current, going to the bottom at once, if disturbed. They are very voracious, feeding on fish, reptiles, or any animal substance that falls in their way. They take the hook when fished for, and require much

* *Clemmys caspica.* † *Kinosternon pennsylvanicum.* ‡ *Chelydra serpentina.*

management to get them to land. When they leave the water they may be seen on the banks of meadows, with the head, neck, and long tail extended, and after a short walk they fall on their chest, as Alligators do. They are ferocious during captivity, and bite at everything. They are excellent food, and are very widely distributed in nearly all parts of the United States.

One of these aquatic Emydes attains a considerable size, and has a long neck and tail and flat body. The snout is long, and there is a sharp beak on both jaws. There are armour plates on the head, and three strong ridges on the carapace. It is a very active swimmer, and preys upon small fish, and is called Temminck's Snapper.*

The Large-headed Chinese River Tortoise,† with a long flat buckler and a very long tail, lives in the swamps, marshes, and streams, and is sometimes sold in Canton.

Its habits are probably those of the others of its group, and its powerful upper and lower beak would enable it to catch and hold fish. The head is plated, the eye is large, the limbs are scaled, and there is a long tail, which, when the animal is at rest, is curled up under the right margin of the carapace. Mr. Swinhoe kept one alive during the winter at Canton, but it did not eat any food.

The next division of the family Emydes is called the Chelodines, and contains kinds which cannot withdraw the head; the neck bends sideways, and is then stowed away under the overhanging carapace, but not within the plastron. The carapace and plastron are united to the pelvis. Two or three of the species may be noticed. One has been alluded to in describing the general anatomy of the Chelonia as presenting many anomalous characters; it is the Matamata (*Chelys fimbriata*), which grows to a considerable size in Guiana and North Brazil, living in the stagnant pools near the Orinoco and Amazon, or in still water, or in the swamps. It lives on fish and small water-birds, and is a good and quick swimmer, and when it is quiet the peculiar barbules of its head attract fish, for they are not indifferent imitations of worms when in slight movement. The head of this curious animal is depressed, wide, and triangular in outline, and the nostrils are prolonged into a proboscis. Its mouth opens wide, and the jaws are rounded. There are two barbules to the chin. The buckler is very flat and bumpy, and the whole animal looks ragged and very peculiar.

The Snake-necked Tortoises of Monte Video, Buenos Ayres, and Southern Brazil have a flat but large buckler, a long neck, and pointed long head. In them the side to side movement of the neck is admirably seen, and they bring their neck under the front of the carapace by carrying it sideways. They belong to the genus Hydromedusa.

A common kind of this family, which cannot therefore retract its head under the carapace, lives in the streams, rivers, and wet lands of the region of the Orinoco, Amazon, and other northern rivers of South America. It attains sometimes the length of thirty-two inches, and is an excellent swimmer and catcher of small fish. They are extremely numerous in some places, and assemble in crowds to sun themselves in the early part of the year, on the warm sand near the rivers. A little later they spend the day on the river banks, and in March they take to the river, and swim to the islets to lay their eggs. A few days before the laying commences, these Large Greaved Tortoises‡ line the shallow water in great rows, their heads just appearing above the water. The eggs are large, spherical, and white, and form an important part of the diet of the Indians. Large holes are made by the animals, and sets of eggs are laid by different individuals in them. Bates, when at Ega, on the Amazon, had, like the natives, to live for a considerable part of the year on this great fresh-water Turtle, as it is often called. It was the only animal food, except fish, which was to be had; and although all the arts of the native cuisine were employed, he got thoroughly tired of it. The Indians make a little place close to their homes, where they keep a stock of these "Turtles." They are caught with nets, and there is a great excitement during the hauling in; moreover, they are often harpooned in a clever manner. Bates describes the sand about a mile from the river as yielding up the newly-hatched creatures, which, after boring their way out of the sand in which the eggs had been placed, made their way in thousands, in a direct line, to their favourite element. The natives dry the eggs of this "Aiyussa" Tortoise by placing them on boards, in the smoke of a fire.

It is remarkable that this family should not only be represented in South America, but also in Africa and Australia.

* *Macroclemmys temminckii.* † *Platysternon megacephalum.* ‡ *Podocnemis expansa.*

One genus of it has its plastron movable in front and a flat plated head. Its species are African and Madagascan. One of them (*Sternotherus sinuatus*) was found by Dr. Andrew Smith in rivers to the north of 25° south latitude, and where the water was very deep. They were usually observed during the heat of the day lying upon rocks which projected above the surface of the water, and they were so vigilant that it was almost impossible to approach them within a moderate distance. They are long, rather high-bucklered creatures, the ovate shell being broadest behind. It is dark greenish-brown above, and the upper part of the costal plates are livid grey, whilst the plastron is pale orange, tinted with red. Its eyes are straw-yellow, and so is the head, but it is marbled with greenish-yellow.

The long-necked Pelomedusa is not uncommon, according to W. T. Blanford, in the Auseba river and its tributaries in Abyssinia. But as these rivers dry up in the hot season, the creature must bury itself. It has a most offensive smell.

The Long-necked Chelodine (*Chelodina longicollis*), from the Murray region of Australia, and the Oblong Chelodine (*Chelodina oblonga*), from West Australia, belong to this family, which is thus represented in widely separated regions.

FAMILY III.—THE TRIONYCIDES.—THE MUD OR SOFT TORTOISES.

These have the carapace flat, oval, and incompletely ossified, and therefore more or less gristly and soft at the margins. The plastron, moreover, has not its pieces joined together by bone, and the covering is of skin, and not of tortoiseshell. They have a long neck, and the head is narrowed in front into a kind of snout, in which are the nostrils. These Soft Tortoises are dwellers in the rivers and streams, and even the arms of the sea, in the tropics of the Old and New World. They swim on the surface and midway down, with equal rapidity, and pursue their prey in the water, where, however, they are not without their enemies. Their colour assimilates to a certain extent with the mud, so far as the carapace is concerned, but they are usually light-coloured beneath, so that they may be brown, grey, or speckled above, and whitish, rosy, or bluish below. There is some ornamentation, in the form of numerous yellow, brown, or black lines on each side of the carapace and on the limbs in some kinds. The jaws have a skin like a lip, and the soft skin of the head has no tympanic membrane visible on it. A corresponding skin without plates on it is on the limbs, which are somewhat flattened, and more or less fin-like. Their extremities are webbed for swimming, and they have five digits on each, but only three nails. It may be noticed that the costal plates of the carapace are short, and that the marginal ossicles or plates are absent. They can draw in the neck, but not the head and limbs, within the buckler. These Soft Tortoises are carnivorous and very agile, and they catch anything that is not beyond a certain size which frequents their waters, young Crocodiles and fish especially ; and, moreover, they devour the eggs of these great reptiles. When they are about to seize their prey they dart out their long head and neck with great rapidity, and bite and hold on fiercely, taking out a piece rather than loosening their hold. The eggs are membranous, with some little shell on them, and are numerous. The Soft Tortoises are found in the streams, great fresh-water lakes, and rivers of the hotter parts of Africa, Asia, and America, but on this last continent some are found in higher latitudes in the Wabash river. One common kind, the Spiny Trionyx, or Gymnopus, used to be a common species from New York to Pennsylvania and the Rocky Mountains, and it has been found in the Yellowstone River. It is often confounded with the *Trionyx ferox*, which appears to have a more southern home. They have a large carapace, which floats behind and has a cartilaginous circumference, and the plastron is too narrow to hide the limbs much, and there is a row of short spines along the front edge of the carapace. They retreat out of the water among rocks and the stumps of trees, plunging in again on the slightest alarm. They may be taken with a hook and line baited with a little fish, but they are apt to jerk out their heads suddenly and to seize their captor, biting him severely. Like many of the Mud Tortoises, their flesh is very nice. The females, like all others of the order, seek out spots and bury their eggs, which are numerous.

The other Soft-shelled Tortoise (*Trionyx ferox*, see p. 241) grows to a foot and more in length, and is a voracious animal, feeding on fish and reptiles, and taking the hook, but in confinement it is difficult to feed. They kill the young Alligators, and are eaten by the old ones, and reside almost constantly in the water, and come out and bask in the sun. When provoked, they dart their

CATCHING GREEN TURTLES.

long head and neck forward with great velocity, and often spring upwards, making a loud hiss. The females lay their eggs in dry sand. They inhabit the rivers flowing into the northern borders of the Gulf of Mexico, the Mississippi and its tributaries, to the foot of the Rocky Mountains, the northern lakes, and the Mohawk, but not any other Atlantic stream.

One genus of these Mud Tortoises (Cryptopus) has the plastron so arranged behind, as to close the opening between it and the carapace completely, by means of a kind of gristly lid on each side, the tail opening having a special one. There is a Southern Indian kind, and it is rather common on the coast of Coromandel, living in fresh water. It forms an article of diet. There is another species in the river Senegal in Africa.

The Egyptian Trionyx is probably the ἑμύς of Pliny, and inhabits the Nile and some other African rivers. It is sometimes three feet in length, and is a great enemy to the Crocodiles, devouring their eggs and young.

The Gangetic Trionyx* has the bony carapace rather longer than broad, with a slight swelling in front on the vertebral line. Its surface is coarse and rugged without prominent tubercles. The species is found in the Ganges and its tributaries upwards to Nepal, and at Penang, and in rivers, and on the sea coast. It has a fierce disposition, and defends itself desperately by biting, and it utters a low, hoarse, cackling noise. The largest shell is twenty-three inches in length. Other species are from China, Japan, Camboja, Borneo, and Singapore, and the Philippine Islands.

The genus Cycloderma is one of this family, and a species is called the Senegal Mud Turtle.

FAMILY IV.—THE CHELONIADES.—THE MARINE CHELONIANS.—THE TURTLES.

There are three genera in this family, two of which have much in common, but the third differs from the others considerably. All have the extremities adapted for swimming, and the carapace and plastron more or less incomplete in the bony parts. The first genus (Chelonia) contains the Edible Turtles, of which there may be more than one species, but the type is the Green Turtle of commerce and city feasts (*Chelonia midas*).† They are free swimmers in the great oceans within the tropics, and sometimes they wander beyond this limit. Liking deep water—for much of their prey is found in the warm surface water, not near shallows—they beach themselves on almost all the islands where there is a sandy shore in which they can dig a hole and deposit their eggs. They are seen very generally about the warmer parts of the ocean within a few miles of land, and also hundreds of miles and farther from it, swimming or floating on the surface, and diving for a long time before reappearing. Although cumbersome on land, the largest of them, which may be seven feet in length, and weighing 800lbs. or 900lbs., swim easily and rapidly, and the smaller individuals, which may be watched in an aquarium, are most elegant in their natation, feathering their flat and curved arms with great skill when desiring to change the level of their swim. They live on the gelatinous swimming things of the ocean, the Cuttle-fish tribes, the mollusca without much shell, and probably on fish. When near land they devour marine plants, such as the Zostera, and some are stated to wander on shore after green food. At certain times of the year shoals of them arrive at the laying stations, and usually choosing the night, crawl upon the beach, burrowing, as it were, in the sand with their flippers. The females lay a number of spherical eggs, like tennis-balls in shape, which are slightly flexible and membranous externally. Mr. Moseley, in noticing the Turtles of Ascension Island, writes‡:—"At Ascension Island Turtles are collected, and by the side of the 'pond' in which they are kept there is an enclosed space of sand. The Turtles dig deep holes in it large enough to bury themselves in, and lay their eggs at the bottom. The eggs are always covered up by the Turtle, and evidently require moisture as well as an equable temperature, of no very great amount, however, for the sand in which hatching takes place does not feel warm to the hand, but rather cool. Evidently the former opinion that these eggs were incubated by the direct heat of the sun is erroneous." The fresh egg is not quite full, so that there is a depression or crumple upon it, but shortly before hatching it becomes tense. When

* *Trionyx gangeticus* (Cuvier).

† The Green or Edible Turtle is said to be restricted to the Atlantic Ocean, but this is not the case. It is found in the Western Pacific, in the Tropics, and probably elsewhere in that great ocean. Moseley found them at the Admiralty Islands. Some naturalists make a new species (*Chelonia virgata*) of the East Indian kinds.

‡ "Notes of a Naturalist on board the *Challenger*."

hatched, the young Turtles are lively enough, and are great gormandisers; they use their fore limbs not only in swimming, but also in tearing their food, so as to assist the mouth.

The young are hatched in from eighteen to thirty days, and make their way at once to the sea, being, however, in great danger from many enemies until they reach it, and even then they are preyed upon by Turtle-loving marine creatures. The number which do escape and live must be very great, for the extent of the shores of the Atlantic and of the islands of that ocean visited by laying Turtles is enormous.

Audubon described the life of the Turtles during their egg-laying at the Tortugas, a group of islands about eighty miles from the coast of Florida. After noticing their circumspect approach during the moonlight nights to the shore, and their crawling motion up the beach, he says that the Turtles raise the head to the full stretch of the neck, and after gazing around, form a hole in the sand with the hind flippers, using them as ladles, and casting the earth forth for several feet. This may not go on perhaps for more than nine minutes, and then the eggs are dropped in regular layers, to the number of from 150 to 200. This takes about twenty minutes, and then the sand is scraped over the eggs again, and the Turtles rush back to the water with all speed. It appears that these wanderers in the great ocean return to the same laying-ground during the breeding season.

They are caught on shore by being upset and turned on their backs, and this is usually done with stout poles, as well as with the help of the shoulder, and several men may have to join in doing this to a large individual. They rarely are able to turn back again, and are secured by the legs in the meanwhile. Sometimes nets are used to catch the smaller ones, and harpooning is also resorted to. But the prime object is to capture the Turtle alive for the markets of the great towns of the world.

These Edible Turtles have the carapace depressed, broad, and ornamented, with fifteen disc-shaped horny scales, making up the outside shell. Their head is broad, but the muzzle is short and rounded, and the upper jaw has a slight notch in front and small jagged points on the sides. The horny case of the lower jaw (or beak) is formed of three pieces, and the sides are deeply indented. The tympanum is hidden by skin, and there is a nail on the first toe of each foot.

The tortoiseshell of commerce is the product of the Hawk's-bill Turtle,* and is derived from thirteen overlapping long shields on the carapace. This Turtle does not grow to a great size, and specimens with shells more than two feet long are rare. It is known by the imbricating plates of the carapace, and by the long, compressed, and curved upper jaw, which, with the corresponding front part of the mandible, gives a beak-like look to the front part of the head. It is found in the Indian and Pacific Oceans, and it appears that they lay eggs earlier and are more prolific than the other Turtles. But they are not of value for the table. The young ones have the shell with three keels to it, and all have small horny scales imbedded in the skin of the neck. They are carnivorous, and feed on fish, mollusca, and crustacea, and Mr. Moseley states that the pretty green Velellæ which float on the surface are its prey in the wide ocean.

The thin imbricating plates constitute the tortoiseshell of commerce, and much of its value depends upon the manner in which, and the time at which, it is removed from the animal. If taken off when the animal is putrid the tortoiseshell becomes clouded and milky, and hence the cruel expedient is resorted to of suspending the Turtle over fire till the heat makes the shield to start from the bony part of the carapace, after which the creature is allowed to escape to the water.† In Celebes, whence the finest shell is exported to China, the animals are killed by blows on the head, and the carapace is immersed in boiling water to detach the plates.

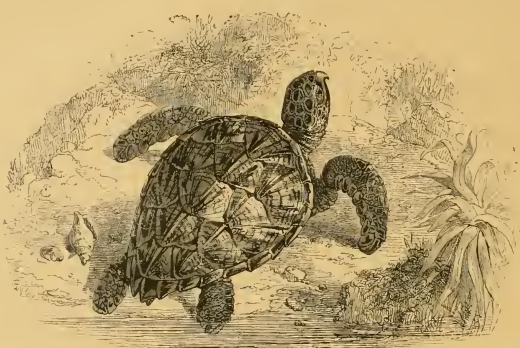
The Logger-headed Turtles‡ are probably of more than one kind. One which frequents the Atlantic and sometimes the Mediterranean Sea is of a brownish or reddish-brown colour, and the middle scales of the carapace have raised crests. Their body is broad in front, and the marginal rim is thin and broad behind. The scales are thin and flexible. There are fifteen vertebral and costal shields, and they are thin, but do not overlap.

The fore part of the jaws is beaked, but not elongated, and the head is low, broad, and flat on the top. Their fore feet are larger than those of the other Turtles. It would appear that their habits resemble those of the others, but the powerful beak enables them to crush Mollusca and Crustacea with thick shells.

* *Chelonia* (*Caretta*) *squamata*. † Tennent: "Natural History, Ceylon." p. 293. ‡ *Caouana* = *Thalassochelys olivacea*.

The Atlantic species of the Loggerhead does not appear to extend into the Indian Ocean; and a single-clawed, long, fore-limbed kind exists there. It is the Indian Loggerhead. The shell is never much over two feet in length, and the flesh is not eaten, except by the natives of the coasts of the Bay of Bengal, of Malabar, and the Philippines.

The last genus to be noticed is that of the Leather-back Turtles, whose carapace is not covered with scales of shell, but with a dense coriaceous skin. These Turtles make a roaring noise under certain circumstances, and hence have been included in the genus Sphargis.* They have large fore limbs and smaller hind ones, and there are no nails. The jaws are dentilated, and the skin of the back is in longitudinal ridges. They grow to a great size, and inhabit the Atlantic and the Mediterranean, and



HAWK'S BILL TURTLE.

have been cast on English coasts, having wandered to the north of their usual limits; moreover, they are found in the temperate zones of all the great oceans. The Sphargis' shell has seven long projecting ridges along it, separated by grooves, and the skin is smooth in adults, but tubercular in young ones. The fore and hind extremities are well developed, and the digits are exceedingly long and form admirable paddles.

The most important points in the anatomy of the Turtles have been noticed in describing that of the Tortoise, and it is only necessary to remark on their great tenacity of life, the great independence of their muscular system, so far as the nervous centres are concerned, and the long-continued energy of their heart after its removal from the body.

THE EXTINCT CHELONIANS.

The Chelonians are a very ancient order, and their remains have been found fossilised, especially the limb bones and the carapace and plastron, these being often marked with the impressions of the tortoiseshell plates.

There are some impressions of feet which have been attributed to the Chelonians in the Trias of Scotland, but it is very doubtful whether they can be referred to them. The first definite evidence of their former existence, is in the Oolitic age. In Europe they have been discovered in the Stonesfield slate, in the lithographic slate of Ciron, in the Portland stone, and in the Purbeck strata. The Marine Turtles are represented in the Portland stone by *Chelone planiceps*, and two singularly-marked genera, Tretosternon and Pleurosternon (Owen), were discovered in the Purbeck. Probably they are allied to Trionyx. One of the Purbeck fossil Chelonians belonging to the genus Pleurosternon was believed by

* *Spharyis coriacea*, σφαραγίζω, to roar loudly.

Dr. Gray to belong to a group now represented in Yucatan—Dermatoclemys. In the Wealden there are the remains of a Marine Turtle; and the true marine forms, *Chelone camperi*, *C. benstedi*, and *C. pulchriceps*, and a Protemys are from the Cretaceous series. The number of Turtles in the London Clay is great, and the skull of *Chelone gigas* measures a foot across. One resembles a Trionyx in the shape of its snout, but its carapace and plastron are well ossified, and it is called *Chelone longiceps*. The Eocene of Hordwell yielded a "Soft Turtle;" this Trionyx is accompanied by eight fossil Emydes. The order is represented in the Miocene and Pliocene of Europe, and in the Tertiaries of America, and the gigantic sub-Himalayan *Colossochelys atlas* is accompanied by the recent *Emys tecta* (Gray). Finally, the island of Malta has yielded gigantic Tortoise remains, which are allied to the recent and extinct series of the Mascarenes and of the Galapagos Islands. Descriptions of the fossil Chelonians of the United States are to be found in the magnificent work of Cope on the "Vertebrata of the Cretaceous Formations of the West," a book given to most European naturalists by the wise generosity of the Senate, and Dr. Hayden, head of the Geological Survey. The Tertiary strata have yielded fossil Trionycides and species of Emys allied to modern American kinds; and Cope discovered in the chalk of Kansas a huge Turtle with flippers considerably over fifteen feet in length, and this Protostega had the bony characters of a youthful modern form. It is allied to Sphargis. Equally interesting is the genus Plastomenas of Cope, which embraces the anatomical characters of Trionyx and Emys, and which is found at the top of the Cretaceous and in the Eocene. Trionyx has been found in the Green Sand of New Jersey, and Leidy has described one from the celebrated Bad Lands of Montana. A form with a long tail like Chelydra, and as long as Temminck's Snapper, has been described by Cope, and was found with his great Turtle. As yet no Land Tortoises have been discovered fossil in America.

The European Emys has been found in England in a sub-fossil condition.

Günther states that the Mascarene great Tortoises *Testudo triserrata*, *T. inepta*, and two others are extinct, and that there is *Testudo vosmaeri* extinct in the island of Rodriguez. *Testudo ephippium* of the Galapagos Archipalago is also one of these lately extinct forms.

CLASSIFICATION OF THE ORDER CHELONIA AND OF THE PRINCIPAL GENERA.

FAMILY I.—TESTUDINES	Genus Testudo.
	,, Pyxis.
	,, Kynixys
FAMILY II.—EMYDES	,, Cistudo.
	,, Cyclemys.
	,, Emys.
SUB-FAMILY EMYDA	,, Rinosternon.
	,, Chelydra.
	,, Platysternon.
	,, Macroclemmys.
SUB-FAMILY CHELODINA	,, Chelodina.
	,, Hydromedusa.
	,, Pelomedusa.
	,, Sternotherus.
	,, Podocnemis.
	,, Chelys.
TRANSITION SUB-FAMILY	,, Cyclanosteus.
FAMILY III.—TRIONYCIDES	,, Trionyx.
	,, Cycloderma.
FAMILY IV.—CHELONIADES	,, Chelonia = Caretta.
	,, Caouana = Thalassochelys.
	,, Sphargis.

CHAPTER II.

ORDER CROCODILIA.—THE CROCODILES, GAVIALS, AND ALLIGATORS.

THE CROCODILE FAMILY.—Worshipped by Ancient Egyptians—The Crocodile of the Nile—Appearance—Peculiar Nature of the Tooth-growth—Arrangement for Sinking with its Prey without allowing Water to Pass into the Throat—How it Obtains Fresh Supplies of Air—How it Disposes of its Food—Remarkable Eye—"Crocodiles' Tears"—Distribution—Other African Forms—The Eggs of the Crocodile—The Baby Reptiles—The Indian Species—The Salt-water Crocodile—Description—How it Procures its Food—The Marsh Crocodile—Appearance—Worshipped by Fakirs—Ferocity of the Indian Crocodiles after their Torpidity—The Victim's only Way of Safety—Crocodile of North-east Australia—The American Kinds—Crocodilus Acutus—The Cuba Crocodile—THE GAVIAL FAMILY—The Gavial—Distinctive Features Habits—Second Forms of the Family—THE ALLIGATOR FAMILY—Difference between Crocodiles and Alligators Characters of the Alligator—The Mississippi, or Pike-headed Alligator Habitat Origin of its Name—Appearance—The Caimans—Characters—The Jacares—Bates's Account of the Alligators of the Amazons—Other Kinds of Jacare—FOSSIL CROCODILIA—Number in Secondary and Tertiary Ages—Antiquity of the Group—Marine Group not handed down—Characters—Terrestrial Forms of the Trias—The Theriodontia—Hyposaurus and Bottosaurus—Classification of the Order.

THE CROCODILE FAMILY.

THE Crocodile is so associated with the Nile of Egypt at the present time, that it is not surprising to find that it was well known to the ancient Egyptians, who worshipped, symbolised, and mummified this monster of their great river. It was one of the symbols of Typhon, the brother of Osiris, who was considered by the Egyptians to be the cause of every evil. One of their deities was a man with a Crocodile's head, called *Souk*. In some parts the Crocodile was eaten, whilst in others it was fed up when young with cakes and roast meat, and these, with wine, were crammed down their throats, whether they liked it or not. The name is of Greek origin, and the Egyptians gave it an appellation which sounded like χαμψαι. Champsa lasts still in modern Egyptian as Temsa. The large adults were sometimes caught and sent to Rome, and Augustus introduced thirty-six into an amphitheatre, where they were all killed by gladiators. Pets were made of the young Crocodiles of the Nile in the olden time, and the Egyptian priests hung rings of gold and precious stones in the protecting membrane of their ears, which they pierced for the purpose; they put bracelets on their fore-feet, and presented them, thus adorned, to the people, who looked at them with great veneration.

The Crocodile of the Nile* may be considered as the type of the order to which it belongs. The body is depressed, long, and protected on the back with solid keeled scales or scutes; the tail is longer than the body, and is compressed laterally and has crests above. The limbs are short and exceedingly powerful, and the toes are united, more or less, by a web. There are five digits on the fore limbs and four on the hinder, and nails are found on three digits fore and aft. The head is broad behind, depressed, with a muzzle, the nostrils being near the front and capable of being closed. The gape of the jaw reaches back beyond the skull, and the tongue is fleshy, not protractile, and is attached to the sides of the lower jaw within the mouth. The tympanic membrane has a valve or ear-lid.

The body of the Crocodile is carried near the ground in walking, and the hinder part of the belly drags usually, so that the limbs are set so as to permit the long bones to spread out as it were. The hind legs have a toothed crest behind, which is formed of about twelve scales. The limbs are covered with squarish and simple small scutes, and the digits also. The fore limbs are the shortest, and the two outer digits are without claws. The colour of the skin of the Nile Crocodile differs with the varieties of the species. In one the back is olive-green speckled with black, and there are two or three oblique bands of this colour on each flank. In another the upper part of the body is olive-green sprinkled with black on the head and neck, and marked with the same colour on the back and tail; two or three large oblique black bands show themselves on each flank, and the under part of the body is of a greenish-yellow colour. The nails are brown. A third has the upper part of the body sprinkled with black angular stains.

The head of a Crocodile strikes the observer more than any other part, on account of its length of jaw and the number of teeth exposed to view along the often festooned, rather than straight, jaws. The canines of the lower jaw, having a groove in the upper jaw-bone for their reception, are very

* *Crocodilus vulgaris* (Geoff.)

striking; and it will be found that the pits in the pre-maxillary bones, for the reception of the tops of the lower incisors, are sometimes perforations. The teeth are all sharp, conical, and tapering where visible, but they have a hollow cylindrical fang, which is set in a special hole or alveolus in the jaw. Crocodiles snap and tear, and thus wear or drag out their teeth, and they are constantly replaced by larger ones, for the creature's first teeth bear but a small relation in size to those of old age. Each tooth is hollowed out at the fang, so as to serve for the case or sheath of the germ of the tooth destined to replace it, which is to be larger. The sockets for the teeth are surrounded by the bone of the pre-maxillary and maxillary bones of the upper and dentary bones of the lower jaw, and are fixed in so as to be very strong, and a fleshy cover extends around their starting-point from the jaw. As the animal grows old, the size of the teeth is not the same in all parts of the jaws.

GROWTH OF TOOTH OF CROCODILE.

(c), Tooth fully developed; (b), Tooth nearly developed to succeed a; (c), germ of third Tooth which in due time will succeed and displace b.

Seizing its prey, the Crocodile, if there is any struggle, drowns it, and can manage to do so with its jaws stretched out grasping its prey, for it has a special structural arrangement by which the water is prevented from rushing down its own throat and producing suffocation. First of all, before noticing this, it must be stated that, unlike the Chelonian reptiles, the Crocodilia can breathe with the mouth open, and that the air rushes into their lungs when their movable ribs expand; for although the skin is tough and armour-plated, it is not supported by a bony expansion which restricts the movements of the ribs. They have a more or less rudimentary, but still very useful, diaphragm.

The nostrils of the Crocodilia, situated near the end of the snout, are capable of being closed at the will of the animal, and they are connected in the snout with a passage, which is limited below, not as in the Mammalia, by palate-bones alone, but also by pterygoids, and which opens far back in the throat. The roof of the mouth has a membrane on it that ends backwards in a fold which, taking away the uvula, resembles that of man in position. This upper fold rests on the back of the tongue when the mouth is closed, and the air passes above and behind it into the throat before reaching the lungs. The tongue is a large flabby structure, incapable of protrusion, and has a hyoid bone at its broad hinder part in the throat, and on it and the tongue is a lower flap of membrane reaching across the throat, and parallel at its free edge with the upper fold. When the Crocodile drags a struggling animal into the water in its jaw-grip, it shuts its nostrils, sinks down, and closes the back of its throat by muscular action, which brings the upper and lower membrane folds together. No water can then pass into the throat. After a while the Crocodile just raises the tip of its snout above water, opens the valves of its nostrils and takes in air, which passes along the passage above the palate, behind the folds of skin into the throat, and thence into the lungs. It tears its prey, if soft; should it not be able to bolt it, it hides it away until decomposition softens the tissues and permits them to be swallowed. The food passes along a narrow long gullet and œsophagus to a single globular stomach, the mucous membrane of the passage being folded and villous, but that of the stomach is very thin. The opening in the stomach for the intestine is close to that for the œsophagus, and there is a small pyloric *cul-de-sac* separated off from the main cavity, through which food must pass into the intestine. The stomach has the mucous membrane thin, and it is folded and placed in serpentine ridges: the cellular coat outside it is thick, and the more external muscular tunic, made up of fibres radiating from the centre to the circumference, issuing from a kind of disc of membrane, is very strong. This stomach is not without its resemblance to the gizzard of a Heron. The food gets crushed and digested in part there, and passes into a much-folded small intestine, with a peculiar glandular layer, and then into a large gut with internal projections on its membrane.

The organs of special sense are elaborate in the Crocodilia. Thus the eye may have a vertical or a horizontal pupil, according to the nocturnal or crepuscular habits of the species, and all have the ciliary processes fully and beautifully developed. A peculiar vascular membrane, covered with pigment, projects into the vitreous humour of the globe, and then is connected with the capsule of the lens. The upper and lower eyelids are well developed. There is a transparent nictitating membrane moved by a special muscular apparatus, and there is a gland especially destined to facilitate the move-

ments of this eye-protector, and its secretion escapes through a duct opening upon its inner surface. "Crocodiles' tears" are household worlds, and the reptiles have a large lachrymal gland to each eye. The ear has an outside lid or valve, which can be shut down when the Crocodile dives, and it protects the tympanic membrane, which is otherwise exposed.

The heart has two auricles, and the ventricle is more or less divided into two by a septum, or by a cellular arrangement which produces a certain amount of separation of the purified and impure blood.*

The Nile Crocodile has a wide distribution in Africa, from Egypt to Senegal, and south to near the Cape, and in Central Africa. Specimens are in the British Museum fifteen feet in length, and it will be noticed that the feet are webbed, that the nasal bones form a projection which separates the hinder edges of the nostril, and that the forehead is flat.

There are two other Crocodiles in Africa, and they are from the west coast. One is very singular-looking, from its long thin snout,† which is truly Crocodilian, from the lower canines being seen to bite in a groove in the upper jaw.

This long, slender-snouted Crocodile grows to a large size, and lives in West and Central Africa, the Gaboon, and the neighbourhood of Lagos. It has plain orbits, and the nasal bones do not reach the nostril.

The Black African Crocodile ‡ is from Western Africa, Senegal, Gaboon, and the Ogové River, and is very unlike its fellow just mentioned, having a broad, short face (like an Alligator), with two bony plates on the eyelids, a turn-up nose; and the nostril is divided in half by the nasal bones, which form a small part of it. The line of the teeth of the upper jaw is very wavy, and they are rather blunt-topped. Its habits are probably those of the Common Crocodile.

The Madagascar Crocodile has the snout longer, slenderer, and with straighter sides than the Nilotic Crocodiles.

The eggs of the Crocodiles are small, not larger than those of a Goose, and the little ones come forth very like the parents in shape, with large-looking eyes, a great gape, and a fine set of sharp teeth. Herodotus noticed the wonderful difference in size between the egg and its little tenant at birth and that of the full-grown reptile, and it is indeed very remarkable.

There are two well-known species of the genus in India, one of which is the Salt-water Crocodile,‖ which lives in the estuaries of the great rivers and makes its way to sea for a while, and the other is the River and Marsh Crocodile, which is found well in the interior, and even up in the outer Himalayan valleys in not very warm water.

The first is a large reptile, with many of the characters of a Nilotic Crocodile, but it differs in the arrangement of the scales behind the head. It has no nuchal scales, and the dorsal ones are oval and long, instead of being as broad as long. It grows to a length of fifteen feet commonly, and it is said to reach double that size. One skull is thirty-one inches long, and, in common with all of its kind, has a long ridge on the face.

A considerable part of the food of this Crocodile is fish, which fall an easy prey, especially to the smaller and youthful reptiles. The old ones, requiring much food, attack every large animal which accidentally approaches them, and in overpowering it the whole of their powers are called into play. Seizing the victim between their capacious jaws, and fastening their long-pointed conical teeth into its flesh, they drag it below water and drown it. As they cannot swallow their large prey they mangle it, tearing off pieces by sudden strong jerks. This is performed by lateral motions of the head and front part of the body.

When the animal, in one of its favourite positions, floats with just the upper part of the head and back out of water, it can still breathe, hear, and see; and when it dives, the nostrils are closed by valves, a transparent membrana nictitans is drawn over the eye, and the ear, a horizontal slit, is shut up by a movable projecting flap of the skin.

* The vertebræ have their bodies hollow in front, and are procelous, and swollen behind, so as to admit of much motion. There are so-called uncinate processes to the ribs, and in the neck they form a remarkable lateral protection of a strengthening kind.

† *Crocodilus cataphractus* (Cuvier)=*Mecistops cataphractus* (Gray).

‡ *Crocodilus niger* (Latr.)=*C. palpebrosus* (Cuvier)=*Osteolemus tetraspes* (Cope)=*Crocodilus frontarosus* (Murray).

‖ *Crocodilus porosus* (Schn.)=*Crocodilus biporcatus* (Cuvier).

The other Crocodile, which may attain the same size as the last, but is usually found smaller, is the Marsh Crocodile,* which has also been called *Crocodilus bombifrons*. It is found in the Ganges, and at Malabar, Madras, Ceylon, and in the Indus. Its snout is covered with numerous small irregular prominences, and the space between the eyes is deeply concave.

It is often called Alligator by European residents, but it is a true Crocodile. It is a ferocious reptile, and is worshipped and kept by some religionists. Thus, about eight miles north of Kárachi,

CROCODILUS ACUTUS.

in Sind, there are some hot springs which swarm with these "Muggars." They are tame, and know their Fakir friends, who watch and feed them.

A species of the genus inhabits Siam and Camboja, and is called the Siamese Muggar,† and has a close resemblance to the Marsh Crocodile of India, the face being much larger, however, and not so bumpy, but there is a small knot in front of the orbit. Another is an inhabitant of the rivers and estuaries of Southern India, and has been called the Pondicherry Crocodile.‡

* *Crocodilus palustris* (Less.). † *Crocodilus siamensis* (Schn.).

‡ *Crocodilus pondicherrianus* (Gray).

The Indian Crocodiles inhabit not only rivers and estuaries, but the sea-coasts, and they may be seen floating two or three miles from shore in calm weather. Those inhabiting small inland waters which are dried up in the rainless season bury themselves and remain in a state of torpor until the rains come, when they emerge and are dangerous and hungry. They then will attack man, who has but one means of saving his life or limb, namely, to force his fingers into the eyes of the beast, which immediately lets go its victim, a practice equally known to the Indian of South America, in relation to Alligators, to the negro of Africa, and to the Hindoo. It has been said that a single Crocodile will often appropriate to himself a limited district, which, if it happens to be in the vicinity of a village, will soon be perceived in the loss of the grazing cattle.

North-eastern Australia has yielded a Crocodile of very unusual shape of head, and it was discovered by Mr. Johnston, of Cardwell, Rockingham Bay, Queensland. Its head and snout are very long, slender, and conical; the forehead is flat between the eyes, and there is a slight convex narrow ridge in front to the middle of the beak. It is called *Crocodilus johnstoni* (Gray).

There are two kinds of Crocodile in America; one is well known, from its very elongate head * and the constriction of the muzzle just behind the large pre-maxillary bones, and from its habits, which are notably interesting to geologists. It has a great range, being found in many of the rivers of the north-east of South America, in Central America, and in some of the West Indian Islands. It has been found in Ecuador, New Granada, Venezuela, Yucatan, Guatemala, Southern Mexico, Cuba, San Domingo, Jamaica, and West Coast of America. A free swimmer, it takes to the sea, and in this, and to a certain extent in the shape of its snout, resembles some of the Teleosaurs of old which geologists classify as Marine Crocodiles. It preys on large and small animals, and the Jaguar and Tapir fall victims to it, as well as fish. The face is slender, and the forehead is swollen and convex; the nasal bones recede and the muzzle is conical, oblong, and the nostril is not separated by a ridge. There are two or four small nuchal plates. The legs are fringed and the toes are webbed. Mr. Gray describes an Orinoco Crocodile, which is probably a variety of this one.

The other American kind is the Cuba Crocodile, or the Aquez palin,† which inhabits Cuba, Mexico, part of South America, and Yucatan. It has an oblong face, with a very convex forehead, a ridge in front of each orbit converging in front and forming a lozenge-shaped space. There are two or four nuchal plates, and the cervical disc is rhombic and of six large plates. The toes are short in this kind, and the web is very small.

THE GAVIAL FAMILY.

The Gavial,‡ or Nakoo, is a large reptile, with very much of the shape of the Crocodile, but with an exceedingly long and slender face, and the snout with the end swollen, and a great set of teeth. The teeth are tolerably equal, and the first tooth of the lower jaw, as well as the fourth, bites into grooves in the upper; the side teeth are oblique, and altogether there may be twenty-eight above and twenty-six below. The nostrils are large, and the nasal bone does not form part of them. The orbits look very prominent, because their front margin is much raised, and the back of the head looks massive, because the cervical and dorsal plates form a continuous shield, and are not separated as in the Nile Crocodile.

It is a lover of the large rivers, of the Ganges especially, and occurs in Nepal, and also in the Malabar rivers, but it has not the range of the Crocodile, which can stand very chilly water. The Gavial is much more aquatic than the Crocodile, and is rarely seen at all, and very rarely indeed out of water. It is a capital swimmer, and its long snout enables it to breathe without showing its body. Fish are its principal prey, and it grows to the length of twenty feet.

The second genus of the Gavial family is an inhabitant of the Island of Borneo and of some of the neighbouring islands, and differs from the Gavial in having a more conical beak, thick at the back; and the side teeth are erect and are received into pits between the upper ones. These are less numerous than in the Gavial of the Ganges, and the nostrils are not expanded, neither is there a ridge to the orbit. ‖

* *Crocodilus acutus* (Geoff.)=*Molinia americana* (Gray)=*Orinoco crocodile.*
† *Crocodilus rhombifer* (Cuvier); *Palinia rhombifer* (Gray).
‡ *Gavialis gangeticus.* ‖ *Tomistoma schlegelii.*

GANGES GAVIAL.

THE ALLIGATOR FAMILY.

The distinctions between Crocodiles and Alligators only require a little more than ordinary observation for their comprehension.

The head of the Alligator is short and broad; that of the Crocodile is longer. The teeth are very unequal in the Alligator, and the large lower canine, or the fourth from the front, enters a hole in the upper jaw, and is more or less hidden when the mouth is closed. The teeth of the Crocodile are less unequal, and the large canine is visible when the mouth is closed, as it fits in a groove on the side of the upper jaw. The hind legs and feet of the Alligators are round, and neither fringed nor ragged, and the toes are not webbed further than the middle, these structures, as has been shown already, being differently developed in the Crocodiles.

The scales of the neck and body are arranged differently in the two reptiles, and in some Alligators they form a continuous armour. With these exceptions the external aspect of the animals is similar; and there is not much difference in their habits, the Alligators rarely, if ever, going down to the sea, while the Crocodiles do so occasionally.

The Alligators form a family, and probably but one genus; but Dr. Gray and others have formed three genera—Alligator, Jacare, and Caiman—and there are several species.

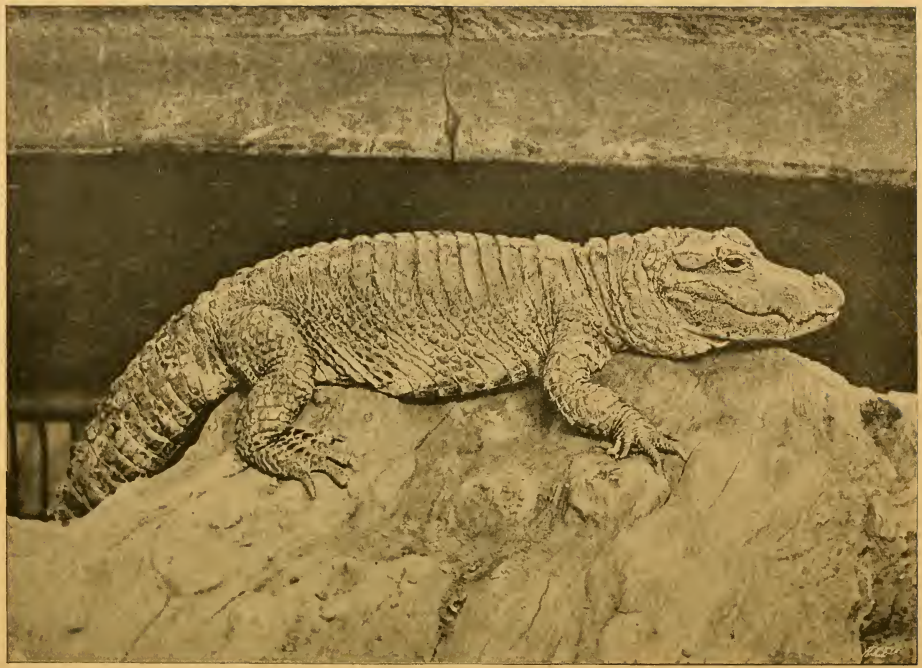
Of the genus Alligator there is the species called the Mississippi Alligator, or the Pike-headed

Alligator.* This formidable reptile formerly inhabited the fresh waters of the Carolinas, the Mississippi, higher than the Red River, and the swamps of Florida, Georgia, and Louisiana, but its present roaming ground is more restricted. Growing to a length of fourteen or fifteen feet, the head is one-seventh of the length, and half as broad at the articulation of the jaws as it is long. The snout is flattened on the upper surface, and it is rounded broadly in front and straight at the sides. The shape of the fore part of the head is so Pike-like that Cuvier gave the Alligator the name of *lucius*—a Pike.

MISSISSIPPI OR PIKE-HEADED ALLIGATOR.

The internal rim of the orbits is large and projects, and the nostrils are separated by a long knob. The skull has two shallow oblique oval pits, with two small holes. The colour is a deep greenish-brown above and a light yellow below, and the sides are more or less striped. They have a bright observant eye, and hiss from the back of the throat, and snap their jaws together, when angry. It is said that men and quadrupeds of some size fall a prey to it whilst bathing, drinking, or crossing rivers, but usually they prey by night, and in companies. Fish are their principal food. It is said that the female digs a hole in the sand, and deposits her eggs in layers separated from one another by layers of leaves and dry grass, and that but one laying occurs in a year. The Alligators hibernate and bury themselves in the mud as soon as cool or cold weather sets in, and come out with the returning heat The eyelids are smooth and fleshy in this Alligator.

* *Alligator lucius.*



CHINESE ALLIGATOR.

(*From the Living Specimen in the Zoological Gardens, London.*)

The Caimans are of two kinds: one is the Rough-backed Caiman,* from Tropical America, and the other the Banded Caiman, from the same region.† They have, unlike the true Alligators, the bony ventral and dorsal scales articulated together. Their smooth eyelids have an internal bony plate, and the cervical scales form an elongated shield. Their head is high, flat at the sides, and angular above. On the side of the neck and body the scales are keeled, but those beneath the body are smooth. In the first species the cervical scales are in five pairs, and the nuchal scales are in a single cross series, whilst in the second the nuchal scales are in two cross series, and the cervical are in three pairs. There are no ridges between the orbits.

The other group, the Jacares, is numerous in species, and they have much in common with the Caimans as regards their armour and eyelid bone. They all have their orbits united by a bony cross ridge, and the eyelids are striated or rugose. They have the head moderately high, and the cervical scales are in pairs forming a bony shield.

One kind, called the Black Jacare,‡ from its black back varied with yellow, attains the length of thirteen feet and more, and inhabits the Amazons near Pera and also Guiana. It has a long head, and the nuchal scales are small and compressed.

Bates, that thoroughly trustworthy naturalist and geographer, who spent so much time in the investigation of the Natural History of the Amazons and its neighbourhood, gives some personal observations on the Alligators of the river. When at Ega, on the Upper Amazons, he wrote:—"Alligators were rather troublesome in the dry season. During these months there was always one or two lying in wait near the bathing-place for anything that might turn up at the edge of the water—dog, sheep, pig, child, or drunken Indian. While this visitor was about, every one took extra care whilst bathing. I used to imitate the natives in not advancing far from the bank, and in keeping my eye fixed on that of the monster, which stares with a disgusting leer along the surface of the water, the body being submerged to the level of the eyes, the top of the head, with part of the dorsal crest, being the only portions visible. When a little motion was perceived in the water behind the reptile's tail, bathers were obliged to beat a quick retreat. I was never threatened myself, but I often saw the crowds of women and children scared whilst bathing, by the beast making a movement towards them. A general scamper to the shore and peals of laughter were always the result in these cases. The men can always destroy these Alligators when they like to take the trouble to set out with montarias and harpoons for the purpose, but they never do it unless one of the monsters, bolder than usual, puts some one's life in danger. This arouses them, and they track the enemy with the greatest pertinacity. When half killed they drag it ashore and despatch it amid loud execrations. Another, however, is sure to appear some days or weeks afterwards and take the vacant place or the station." But under some circumstances the Jacare nigra, the Jacaré-usassú of the Amazonian Indians, is little feared. Thus, when netting the "Turtles" (page 255), which form the staple meat food of the inhabitants, an Alligator was found included, and although the men had jumped into the water to drag and catch the Chelonians, they cared little for a good-sized Alligator, whose jaws, more than a foot long, could have snapped one of their legs in twain. Bates writes:—"No one was alarmed, the only fear expressed being that the imprisoned beast would tear the net. First one shouted, 'I have touched his head!' then another, 'He has scratched my leg!' One of the men, a lanky Miranha, was thrown off his balance, and then there was no end to the laughter and shouting. At last a youth of about fourteen years of age, on my calling to him from the bank to do so, seized the reptile by the tail and held him tightly until, a little resistance being overcome, he was able to bring it ashore. The net was opened, and the boy slowly dragged the dangerous but cowardly beast to land, through muddy water, a distance of about a hundred yards. Meantime I had cut a strong pole from a tree, and as soon as the Alligator was drawn to solid ground, gave him a smart rap with it on the crown of his head, which killed him instantly." The same traveller at one time, when out on an expedition and the heat was very great, found that no one could bathe without being advanced upon by one or other of these hungry monsters. "There was much offal cast into the river, and this, of course, attracted them to the place. One day I amused myself by taking a basketful of fragments of meat beyond the line of ranchos, and drawing the Alligators towards me by feeding them. They behaved pretty much as dogs do when fed, catching the bones I threw them in their

* *Alligator trigonatus*=*Caiman trigonatus* (Gray). † *Caiman palpebrosus* (Gray).
‡ *Jacare nigra* (Gray)=*Alligator sclerops* (Cuvier).

huge jaws, and coming nearer and showing increased eagerness after each morsel. The enormous gape of their mouths, with the blood-red lining and long fringes of teeth, and the uncouth shape of their bodies, made a picture of unsurpassable ugliness. I once or twice fired a heavy charge of shot at them, aiming at the vulnerable part of their bodies, which is a small space situated behind the eyes, but this had no other effect than to make them give a hoarse grunt and shake themselves. They immediately afterwards turned to receive another bone which I threw them."

A small Alligator, not more than two feet in length, the Jacaré curúa, is found in shallow creeks on the Lower Amazons. The Indians said one that was brought to Bates "was a mai d'ovos," or mother of eggs, as they had pillaged the nest which they had found near the edge of the water. The eggs were rather longer than a hen's and regularly oval in shape, presenting a rough, hard surface of shell. This kind was cooked and eaten.

Other Jacares have the head sharp, and the back is olive colour banded with brown, and one of the group, the Dog-headed Jacare,* has the face and snout marked with dark spots at the sides, and the skull is broad and shallow. It inhabits the Brazils about Pernambuco, and also Surinam. The second kind is the Brazilian Jacare. The Long-shielded Jacare of Tropical America has an olive colour, and the jaws are spotted.† It has a long head, no ridges in front of the orbit of any importance, and the cervical disc is oblong, and it much resembles the Eyed Jacare‡ from the lake of Santa Cruz de la Sierra. The Argentine Republic, Brazil, and Surinam, have a narrow-faced, high-nosed Jacare, whose jaws are yellow in colour, or spotted, the back being yellow banded with brown. It is called the Dotted-jawed Jacare.§ And, finally, there is a kind from Demerara called the Rough-necked Jacare,‖ which has the scales on the side of the neck rough, spiny, and pale yellow, the back and tail being brown and cross-barred. The cheeks and sides of the lower jaw are yellow and not spotted.

It was formerly thought that Alligators were confined to the New World, and that all the reptiles of this family living in the Old World were Crocodiles. It is, however, now known that a true Alligator (*Alligator sinensis*) is found in China, and in 1890 two specimens were exhibited in the Zoological Gardens, Regent's Park.

FOSSIL CROCODILIA.

So numerous were the Crocodilia in the Secondary and Tertiary ages that a considerable volume might be written upon their characteristics and localities; therefore a short summary of their peculiarities can only be given here. In the endeavour to comprehend the structures of the Crocodiles of old, the nature of the vertebræ and of the roof of the mouth of the Nilotic Crocodile should be considered. The modern Crocodilia have the body of the vertebræ in front of the sacrum concave or procœlous in front, and the hard palate is formed by the union of the palate bones and of the pterygoid bones behind them, so that the internal air passage from the outer nostril is far back in the long mouth. This group of Crocodilia, embracing the three modern families of Crocodile, Gavial, and Alligator, has a great antiquity, for Crocodilia with the above anatomical characters, existed in the age of the Green Sand of America and of the Upper Cretaceous of Europe. *Thoracosaurus* (Leidy), *Holops* (Cope), from America, and *Gavialis macrorhynchus*, of the European Chalk, are to be classified with this modern group termed by Owen "Procœlia." The Crocodilia of the Tertiary age found in the London Clay, the Plastic Clay of Meudon, and the Calcaire Grossier of Castelnaudary, and in the Eocene deposits of Bracklesham were large, and all the three families were represented in those times: that is to say, such forms as *Crocodilus toliapicus*, *Crocodilus hantoniensis*, and *Crocodilus dixoni*, are indications that Crocodiles, Alligators, and Gavials lived then in Western Europe. In the later Tertiary deposits the group is represented, and in the Sewalik hills in the Himalayas there is a thick-toothed Crocodile of extinct species, and one which resembles the Muggar.

The great series of strata belonging to the Secondary rocks, from the Lower Lias to the Upper Chalk inclusive, contain evidences of the former existence of another group of Crocodilia. The genera which form it probably led marine and along-shore lives, and the more terrestrial kinds, such as would now be the true Crocodiles and some Alligators, have not been handed down by fossil remains. Gavial-

* *Jacare latirostris* (Gray)=*Alligator cynocephalus* (Dum., et Bib.). † *Jacare longiscutata*.
‡ *Jocare ocellata* (Gray). § *Jacare punctulata* (Gray)=*Jacare sclerops* (Gray). ‖ *Jacare hirticollis* (Gray).

like kinds, which moved out to sea like the Crocodile of San Domingo, but which came rarely to land, existed as the genera Steneosaurus and Teleosaurus. In these Crocodilia, the bodies of the vertebræ were concave before and behind, or amphicœlous, and the pterygoid bones did not come into the hard palate, the posterior nostrils being behind the palatine bones only, and there were two longitudinal series of dorsal scutes instead of more, as in the Procœlia. This group of Amphicœlia became extinct during the early days of the Procœlia.

Mr. Hulke, F.R.S., has shown that in the Wealden and Purbeck deposits there is a fossil Crocodile intermediate in its characters of skull between those of the Lias and Tertiary times.

The next group preceded these in time, and lived and died out in the days of the vast continental surfaces of the Trias. Instead of being perfectly aquatic forms, these Crocodiles were very terrestrial, and the conformation of their nostrils and hard palate leads to the belief that they had no necessity to drown their prey, and that they had not the peculiar method of life of the more modern groups. The bodies of the vertebræ of these early Secondary kinds were amphicœlous, but neither the palatine nor the pterygoid bones were produced into plates, so as to form a hard palate and place the internal nostrils far back in the mouth. Hence the outside nostrils communicated with the mouth in the front part of the palate. They had two long series of keeled, joined, dorsal scutes, and in some there was a ventral armour. The genus Stagonolepis is from Elgin, in Scotland; and Parasuchus from India, and Belodon from Germany and North America. They have been called by Huxley "Parasuchia."

Owen, of whose classification of the fossil Crocodiles the above is a modification, has described some little Crocodilia which he considers were sufficiently large to kill and devour the small Marsupial Mammals of the age of the Purbeck deposits (Upper Oolite).

Associated with the fossil Crocodilia is an order in which large and small reptiles with bi-concave vertebræ have a dentition of teeth in sockets, which somewhat foreshadows the carnivorous Mammalia. These Theriodontia of Professor Owen probably commenced in the Permian age, and lived in the Oural region in Asia, and in North America, South Africa, and England, during one or more of the geological ages down to the end of the Oolite period.

Cope notices two species of Crocodilia from the Cretaceous formations west of the Mississippi; one eight or ten feet in length is Hyposaurus, which had sub-biconcave vertebræ and a long sub-cylindrical snout; and the other was a short-headed species like the *Alligator lucius*. The New Jersey Cretaceous has also yielded Crocodilia of this genus—Bottosaurus as well as Hyposaurus, and there is a long-nosed Gavial from the same strata named Holops by Cope, and a second which is a Procœlian Crocodilian, small in size, but also a Gavial.

CLASSIFICATION OF THE ORDER CROCODILIA.

Family—Crocodilidæ	Genus	Crocodilus.
Gavialidæ	,,	Gavialis.
	,,	Tomistoma.
Alligatoridæ	,,	Alligator.
	,,	Caiman.
	,,	Jacare.

CLASS REPTILIA, THE REPTILES

CHAPTER III.

ORDER SAURIA, OR LACERTILIA.—THE LIZARDS.

THE LIZARDS—Characters of the Reptiles of the Order—THE FISSILINGUES—The Sand Lizard—Prof. Bell's Description—The Common Lizard—Habits—Young Produced Alive—Characters of the Lizard—Distinctions between Crocodile, Lizard, and Snake, illustrated by Comparison of the Skull (foot note)—Other Species of Lacerta—Peculiarity of the Tail of many Lizards—Teeth of Saurians—A "Pleurodont" Jaw—An "Acrodont" Jaw—The Amevidæ—Characters—The Common Teguexin—Habits—The Common Ameiva—The Water Lizards—Description—Why called Monitors—The Nile Monitor—The Sand Monitor, or Varanus—Other Kinds of Varanus—The Common Indian Water Lizard—The Ocellated Water Lizard—The Heloderma—THE CRASSILINGUES—Characters—The Iguanas—The Green Iguana—Description—Habits—Character of the Vertebræ—Dentition Pleurodont. The Basilisk—Appearance—The Amblyrhynchus Cristatus—Darwin's Account of this Sea Lizard—The Terrestrial Species of this Genus—Flying Lizards—Characters—Their Apparatus for Locomotion—Habits—Beauty of their Colouring—The Frilled Lizard—Description—The Frill—The Terrestrial Agamidæ of the Old World and Australia—The Genus Uromastix—The Dabb, or Dhobb—The Thorn-devil, or Horrible Moloch—The Genus Stellio—The Toad Lizards—The Gecko Family—Appearance—Habits—Their Toes and Fingers—Characters—Colouring—Eyes—Tongue—Origin of their Name—Pleurodont Teeth—The Various Species—The Flying Gecko—RHYNCHOCEPHALA, THE BEAKED LIZARDS—The Tuatéra, or Hatteria, or the Sphenodon Lizard—Günther's Description of its Anatomy—THE VERMILINGUES, THE CHAMÆLEONS—Appearance—Curious Tongue—Remarkable Lungs—Distribution—Colouring—The Genus Rhampholeon—The South African Kind—Changing of the Colour of the Chamæleon's Skin—THE AMPHISBÆNOIDA—The White Amphisbæna—THE BREVILINGUES—Characters—Scincoidæ—The Common Skink—Habits—The Stump-tailed Lizard—The Blind-worm, or Slow-worm—Description—The Javelin Snake—The Zonuridæ—Character—The Gigantic Cordylus—The European Pseudopus—American Glass Snake—Classification of the Order Sauria.

The reptiles included in this order are very numerous, and present much diversity of shape and habits. Some resemble the Crocodiles, but have neither their bony plate armour nor their socket-implanted teeth. Others are after the type of the Common Lizard, and the rest are more or less limbless, and in some the shape of the Serpent is recognised. But all have a more or less perfect shoulder-girdle and sternum, and usually, but not invariably, four limbs are present. Their throat is not extensible, and the jaws cannot separate as in the Serpents. Many have glands with pore-like openings on the thighs.

There are many groups of these reptiles, which are subdivided into families. The long-bodied, short-limbed, scaly, long tailed Lizards of England may be considered first of all, as their shape is familiar to everybody. They belong to THE SUB-ORDER FISSILINGUES, THE SPLIT-TONGUED LIZARDS, characterised by having a long, slender, protractile, forked tongue, the teeth pleurodont* in arrangement, a free tympanic membrane, and procœlous vertebræ.

THE SAND LIZARD.†—GENUS LACERTA.

This English species of Lizard received especial attention from Professor Bell, who writes, in his "History of British Reptiles":—"This beautiful species is found in the neighbourhood of Poole, in Dorsetshire, in somewhat different situations. Its general abode is on sandy heaths, where it is frequently seen crossing the small by-paths with considerable swiftness, although it is certainly less rapid in its movements than the next and more common species. But it is occasionally seen on the sunny sides of green banks basking in the sun's rays, and retreating rapidly on the approach of any intruder." It is occasionally seen near wet ground. It is a very timid and wild little thing, and Bell states that it will bite if handled, and that it pines and dies in captivity. It is a northern kind, rarely occurring so far south as Italy, but it is common in the northern parts of France and the central parts of Europe, extending as far north as Denmark and Sweden. In its form, this kind is thick and rounded in the body, the limbs are strong and short, and the head is obtuse.

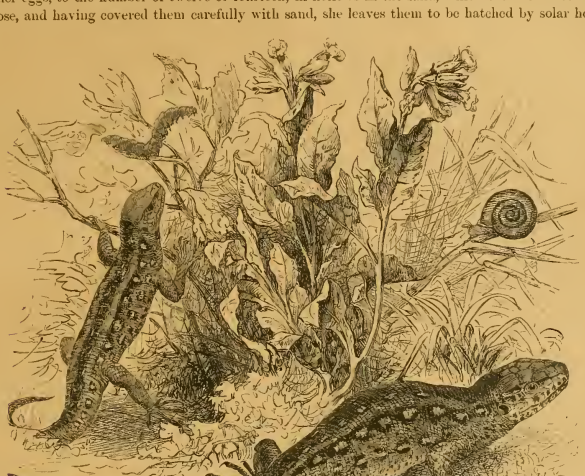
The third and fourth toes of the foot are of equal length. On the head, which is plated, the eyelids have a series of very minute scales. The scales of the upper part of the body are round or polygonal, and slightly keeled. The abdominal plates are in six rows, the middle series being narrower than the adjoining ones. The throat has a distinct collar of scales.

The femoral pores vary from eight to eighteen on each side. The tail is covered with numerous distinct whorls of scales, fifty to eighty in number, and the total length of the Lizard is seven inches two lines, that of the tail being four inches. It has teeth on the palate.

* See page 275.

† *Lacerta agilis* (Linn.).

It varies much in its colour and markings. The most common tint of the upper parts is a sandy-brown, with obscure longitudinal bands of a darker brown, and a lateral set of black round spots, each marked with a yellowish-white dot or line in the centre. There is often, according to Bell, more or less of green on the sides. Some are of a rich brown colour, others of a green hue of a dullish tint, and it is this which has led to the belief that a species called the Green Lizard occurs in England. The female lays her eggs, to the number of twelve or fourteen, in hollows in the sand, which she excavates for the purpose, and having covered them carefully with sand, she leaves them to be hatched by solar heat.



SAND LIZARD.

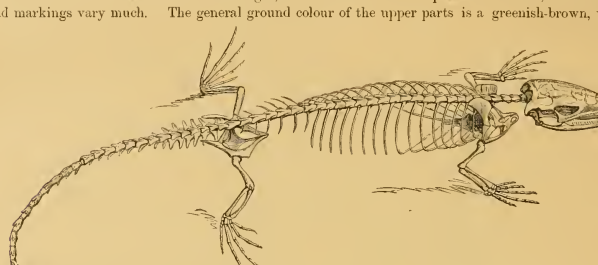
SUB-GENUS ZOOTOCA.—THE COMMON OR VIVIPAROUS LIZARD.*

This Lizard has the temples covered with adpressed scales, and the scales of the back are long and hexagonal, but there are no teeth on the palate. Hence it differs from the Sand Lizard, and has been placed in a sub-genus Zootoca, and as it brings forth its young alive and not within the egg, it is termed the Viviparous Lizard. It is an agile and pretty Lizard, frequenting heaths and banks in England and even in Scotland. It is one of the few reptiles found in Ireland. It is confined to the latitude of England on the Continent. Bell says :—"It comes out of its hiding-place during the warm part of the day, from the early spring till autumn has far advanced, basking in the sun, and turning its head with a sudden motion the instant that an insect comes within its view, and darting like lightning upon its prey, it seizes it with its little sharp teeth, and speedily swallows it.

* *Lacerta* (*Zootoca*) *vivipara*. See note on next page.

Thus, it will often take a great number of the smaller insects, preferring those of the two-winged order, though it will not refuse many of the beetles and Orthoptera, if they are not too large."

The female retains the eggs until the young are ready to leave them, and they are produced alive. The covering of the egg is very thin and membranous. As the young are sometimes found with the mother, it is possible that she has some maternal instincts. The young are fully formed when born, and are capable of running about and of taking care of themselves. This little Lizard is from five inches and a half to six inches and a half in length, of which the head occupies half an inch, and its colour and markings vary much. The general ground colour of the upper parts is a greenish-brown, with a



SKELETON OF THE COMMON LIZARD.

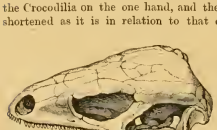
dark brown line down the middle of the back, which is often somewhat interrupted. A broad stripe or belt extends parallel with this on each side, commencing behind the eyes, and extending to a greater or less length down the tail; between this and the former are often one or more rows of black dots, and similar ones may occur on the lines. The under side of the body and base of the tail, in the male, are bright orange, spotted with black; in the female these parts, as well as the tail, are pale greyish-green, without spots.

The other species of Lacerta, which may be seen frequently on the Continent of Europe, are the Green * and the Ocellate † Lizards, and the lively little Wall Lizard.‡

There are some species of Lacerta in Africa, and on that continent, in India, and in Southern Europe, the genus Acanthodactylus is represented. Its species have the toes keeled beneath or fringed along their edges. Long-tailed, cylindrical-bodied Lizards are also found in the East Indies and in Africa, and they belong to the genus Tachydromus. The genus Ophiops contains Lizards without palatal teeth and eyelids, and the type is an inhabitant of Asia Minor.

* *Lacerta viridis.* † *L. ocellata.* ‡ *L. muralis.*

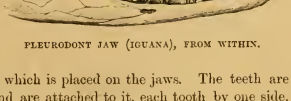
NOTE.—If these common Lizards are taken as the types of the order Sauria, or Lacertilia, the distinctions between them and the Crocodilia on the one hand, and the Serpents, or Ophidia, on the other, can be appreciated. The skull of the Lizard, shortened as it is in relation to that of the Crocodile, possesses the following peculiarities:—The lower jaw is jointed with a quadrate bone, on each side, which is not firmly united to the skull, for the union admits of some movement there. In this respect the Lizards differ from the Crocodiles, but this mobility is in excess in the Serpents. In the Lacertilia the pterygoid bones reach from the palatines and sphenoid backwards and outwards to join, but not to unite firmly to, the quadrate bones; but this is not the case in the Crocodiles, and the joining is in the nature of a very movable joint in the Serpents. In the Sphenodon, one of the Lacertilia, this union is bony, and there is no mobility. On the palate of the Saurians, the inner nostrils or posterior nares are well in front, and the vomers limit them internally, and the palatine bones externally. The palatine bones do not unite along the median line, as in the Crocodile, except in the Sphenodon, and the vomers are distinct in the Lacertilia. There is a transverse bone uniting the palatine and pterygoid with the maxilla in the Lacertilia and Snakes. The basi-sphenoid has a projection on each side which passes downwards and



SKULL OF LIZARD.

Common observation instructs us that many Lizards leave their tails behind in the hand of their incautious captor, without seeming any the worse for this singular loss of much of the organ. The vertebræ of the tail are not solid and bony, for there is a space running right across each, in its middle, formed of gristle, or even of cellular tissue, and this gives way nearest the point of greatest stress upon the tail, which snaps off, but will be reproduced.

Certain skin glands exist, and are seen at the surface along the inner part of the thigh as pores (femoral and inguinal pores), and others exist in front of the vent. They secrete a reddish fatty substance, which often hardens in the duct leading to the pore, and forms a visible projection.



PLEURODONT JAW (IGUANA), FROM WITHIN.

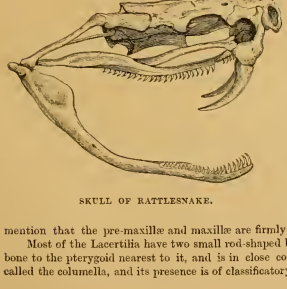
The teeth of the Saurians are on the pre-maxillæ, maxillæ, and the dentary pieces of the lower jaw or mandible, but they often occur also in the pterygoid and palatine bones.

It was mentioned that the teeth of the English Lizards are *pleurodont*. This is a term which implies that the teeth are attached to a kind of parapet of bone which is placed on the jaws. The teeth are inside this, or between it and the cavity of the mouth, and are attached to it, each tooth by one side, and they are therefore not placed in sockets.

This arrangement is common to several groups of the order, and others have what is called an *acrodont* dentition. That is to say, the bases of the teeth are on and are attached to the top of the parapet, and not to its side. The teeth are numerous and simple in structure, and their crowns have very different forms, being sharp, blade-like, or broad, rounded, and crushing, according to the

outwards to join the commencing backward prolongation of the pterygoid. This is seen in the Snake also, but not in the Crocodile; but the junction, perfect in the Lizard, is movable in the Serpents. In the Lizards the space between the prootic bone and the pre-frontal, unlike the bony condition of the Crocodile, is filled with cartilaginous membrane. There is an imperfect bony division between the orbits, and the parietal bones form the front part of the roof of the brain-case, and the occipital the back, hinder, and part of its lower portions; they are not united by sutures or fixed in a perfectly motionless manner, but there is a membranous interspace, which permits of some movement of the face and fore part of the skull on the occipital bone. This is very different to the rigid condition of the skull of the Crocodile and to the solid structures of that of the snake. On looking at the upper part of the Lizard's skull a number of distinct openings are seen. One, the *supra-temporal fossa*, is bounded by the parietal, post-frontal, and the squamosal bones; and there is a *post-* and *temporal fossa* existing between the parietal, the occipital, and a process called the parotic. This process is at the back and side of the skull, giving it an angular appearance. It is present also in the Crocodiles, but it is not found in the Snakes.

SKULL OF CROCODILE.



SKULL OF RATTLESNAKE.

A small unossified space, the *parietal* foramen, usually exists between the parietal bones and the frontals.

There is also a *lateral temporal fossa*. The Lizards have the skin over the *supra-temporal fossa* more or less bony, and it follows that, as in the Crocodile and Chelonians, there is a kind of light outer skull-case, the true brain-case being very small and opening behind at the foramen magnum, where there is, on the basi-occipital bone, at its junction with the lateral occipital bones, the solitary condyle for the jointing with the atlas or first vertebra.

With regard to the lower jaw, the two sides of it are usually united at the chin (or symphysis), and each is composed of six bony pieces. This number is common to the Reptilia, but the junction in front, seen also in the Crocodile, is not observed in the Snake, whose lower jaw is singularly separable from its fellow on its opposite side.

Finally, in concluding this notice of the skull, it is necessary to mention that the pre-maxillæ and maxillæ are firmly united with each other and the skull, and that there are two vomers.

Most of the Lacertilia have two small rod-shaped bones, one on each side within the skull. Each extends from a parietal bone to the pterygoid nearest to it, and is in close contact with the membranous or cartilaginous wall of the skull. It is called the columella, and its presence is of classificatory value.

family or sub-order. New teeth are usually formed below the old ones. Some fossil kinds were probably *thecodont*, or their teeth were in sockets.

The second family of the sub-order Fissilingues is formed by the AMEIVIDÆ. Living in the New World, these large reptiles have the head plated, rhombic scales on the back, and transverse rows of square ones on the belly. The tail is long and cylindrical in some and compressed in others. The limbs are well developed; the teeth are powerful and obliquely placed; there are two transverse folds in the skin of the lower region of the neck, and usually there are femoral pores. The COMMON TEGUEXIN,* or

COMMON TEGUEXIN.

South American Sauvegarde, may be taken as an example. It grows to more than a yard in length, and has been said to attain four feet six inches, and the colour is variable on the back, where it is always black, so far as the ground tint is concerned, but the beautiful yellow spots may be scattered and small, or large and dispersed in cross bands, with a large spot on the flanks. The sprinkling is seen often on the head and tail, and this is ringed with yellow and black. All the lower parts are yellow, and are marked across with black bands. They have a great range in South America, from Guiana to Paraguay inclusive, and are abundant, being found in sugar plantations and woods, and in the Brazils in sandy or clayey districts, amongst scrub and bush. Often liking the neighbourhood of the rivers and water, and running on the banks, they do not appear to go into the water readily, but they can swim gracefully, using the tail as a propeller.

Usually they burrow under the roots of trees, and they keep very much to the same spots, living often in the hollows of trees. Azara says that when pursued they take to the water, and do not climb, but it is doubtful whether they ever swim. They are strong, and swift in movement, not over bold,

* *Tejus teguexin* (Linn.)

but when attacked by dogs will fight and make their tails felt. Running swiftly close to the ground, they sit with the head rather erect. They keep their tongue in very constant movement, but it is very doubtful if they ever emit a warning sound, as some suppose they do, on the approach of wild beasts. The nests of the White Ant, which have been built close to the fallen trees on the outskirts of the forests, are cleared out by the Teguexin, and her eggs, some fifty or sixty in number, are laid therein. Azara says that they feed on fruit, insects, snakes, frogs, young birds, and eggs, and that they are fond of honey; and in captivity they devour meat and mice, and are not amenable to kindness. The genus Tejus may be distinguished by the large hexagonal scales which are between the neck folds, and by the long and narrow ventral plates.

COMMON AMEIVA.

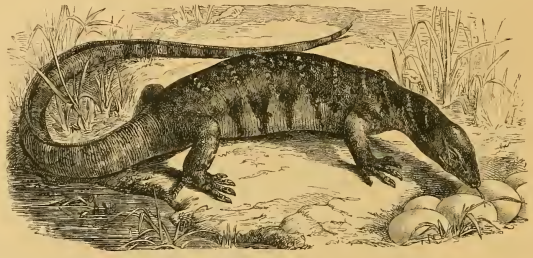
The members of the genus Ameiva have large ventral scales and tricuspid and compressed teeth. *Ameiva vulgaris*, or the Common Ameiva, is from the West Indies.

The largest known Lizards belong to the family of Water Lizards, Monitoridæ, or Platynota. They are long-headed things, with a vast number of small scales, united more or less at the sides and not overlapping, and are equal on the sides and back, and arranged in cross rings, whilst those of the belly and tail are square and in cross bands. The tail is long and generally compressed, and there are five digits to the well-developed limbs armed with claws. The smallness of the shielding of the head is remarkable, but the scales everywhere are usually surrounded by a ring of very small tubercles within their margin. The tongue is long, slender, and ends in a long fork, which retreats into a sheath at the base. The teeth are acute and compressed, triangular or conical, and none are on the palate. They differ from the other Lacertilia, except the American genus Heloderma, which is included in the group, in that the nasal bones are represented by a single narrow ossification. Growing to a considerable size, these largest of the scaly Lizards are found in the Old World, including Africa, South Asia, and in Australia, and there are several genera of them. Some keep entirely to the neighbourhood of water; but others select dry and sandy spots, not always near water. They prey on small reptiles, small mammals, the eggs of reptiles, and will not refuse insects.

They are called Monitors, from it being supposed that they warn people of the neighbourhood and approach of the Crocodile. The warning is said to be a strong hiss, or whistle. But the truth

appears to be that they are often associated with the Crocodiles in the same waters, and give no warning whatever. The NILE MONITOR, or Varanus,* grows to a length of six feet, the tail forming one half. The head is rather long, and the nostrils small and rounded; the tail is keeled on the top, and compressed from side to side, and the fourth toe is the longest, and contrasts with the small fifth one. The reptile has no web to its feet, crawls about watery places, and suns itself on the sand. Known to the ancients as a devourer of Crocodiles' eggs, the Monitor is not restricted to the Nile, although it reaches into Nubia, for it, or a closely allied species, is found in the great rivers of the West, and is known also in South Africa.

In this locality it is generally discovered on the banks of rivers or margins of lakes, and it plunges in the instant it is disturbed; and if the water is deep the Monitor remains quiet there until the danger is past.



NILE MONITOR.

THE SAND MONITOR, OR VARANUS.†

This is an Egyptian kind which, instead of frequenting the banks of the rivers and the water, lives in dry places. It is less carnivorous than the Monitor of the Nile, and its food, although consisting of eggs to a certain extent, is more insectivorous.

Another terrestrial kind is from South Africa. When it is surprised it seeks concealment in the chinks and crevices of the ground, holding on to any projections with its toes, so as to require much force in withdrawing it. A single man is not sufficient for the task, even with a rope attached to the hind legs by way of assistance.

It appears to feed on frogs, crustacea, small mammalia, and is often found near running streams. It is called the White-throated Monitor.‡

Amongst the Varani with nostrils, or an oblique slit placed quite, or nearly, in the middle of the face between the eye, and the end of the snout, are some from India.

The Common Indian Water Lizard§ sometimes attains the length of four feet, the tail being longer than the body, and it is of a brownish olive colour, with more or less numerous black dots, each of which occupies a scale. It is found in Bengal, Nepal, Southern India, and in Ceylon, where it is called the Goana. Kelaart says that "it is found in great abundance in all the maritime provinces, but rarely in the Kandian districts. The natives are partial to its flesh, and we have once tasted some excellent soup made from a Goana, which tasted like hare. They live in holes and come out in mid-day after their food, which consists of smaller reptiles and insects. They attack ant-hills, and at Trincomalee they used to be hunted down by dogs and sold in the market."

The Ocellated, or the Two-banded Water Lizard,‖ lives in China and Siam, and it is said to occur in Ceylon. Cantor says it is very numerous in hilly and marshy localities in the Malayan

* *Monitor* (*Varanus*) *niloticus*. † *Monitor*, or *Psammosaurus arenarius*. ‡ *Monitor* (*Varanus*) *albogularis*.
§ *Monitor* (*Varanus*) *dracæna*. ‖ *Hydrosaurus salvator*=*Varanus salvator*=*Monitor bivittatus*.

Peninsula. It is commonly observed during the day in the branches of trees overhanging rivers, preying on birds and their eggs, and on smaller Lizards, and when disturbed it throws itself from a considerable height into the water, and it will defend itself courageously with teeth, claws, and strokes of the tail. The lowest castes of Hindoos capture these Lizards by digging them out of their burrows on the banks of rivers, for the sake of their flesh, which is greatly relished by these people. Some individuals attain to nearly seven feet in length.

A Monitor, with bright-yellow spots covering five or six scales, and dotted over the whole body, is found in New Guinea and the Darnley Islands,* and a closely allied genus (Hydrosaurus), in which the nostrils are placed at the extremity of the snout, is represented there also.

The Gigantic Lace-Lizard † and its varieties are common examples of Australian kinds.

The other section of this group of Monitors, with a single nasal bone, is represented by the very ugly Lizard called *Heloderma horridum*, of Mexico. It has rather a flat head covered with numerous great convex polygonal plates, which give it a very tubercular appearance.

The Heloderma, reaching to three feet and a few inches in length, is called Escorpion by the natives, and moves chiefly by night. Dissections have shown that Heloderma has poison glands and teeth adapted to bite and introduce the poison. Like most of its order, it is very tenacious of life, and the muscles move long after decapitation, and chloroform is long in killing it.

THE SUB-ORDER CRASSILINGUES.—THE SHORT-TONGUED LIZARDS.

These Lizards have a short, thick, and fleshy tongue, slightly notched in front and not protractile. There are four limbs present, and their digits are placed in front of the ankle and wrist. Usually the eye is protected by lids, and the tympanic membrane is free. They have, with the exception of one family, the Geckos, procœlous vertebræ and a columella, but the teeth may be pleurodont, or acrodont. The first family of this great sub-order is that which contains the IGUANAS (the Iguanidæ).

* *Monitor chlorostigma* (Gray). † *Hydrosaurus giganteus.*

IGUANA.

A large Lizard with a beautiful green-coloured back, yellowish-green sides and belly, with brown stripes or zigzags lined with yellow, and with its long tail ringed with green, yellow, and brown, has a crest of tooth-like spines on the back and tail, a "bag" under the jaw, also crested, long toes, and a rather compressed body. The head is moderately long, and has its top protected with plates, and is raised between the eyes, and is more or less pyramidal in form. The neck is short, and there is a fold of skin on it behind the "bag" which is reflected over the shoulders.

This description applies to the large GREEN IGUANA,* which may be from three to five feet in length. On looking at the mouth it is observed that the numerous teeth are fixed along the internal face of the dentary bone, to which they adhere by one side of their bony root, and that they are remarkable in shape. They are "pleurodont." They are rather long, compressed from side to side, and are broad at the top, where they are angularly arched, pointed at the tip, and finely denticulate on the slope on each side. The tympanic membrane is large and circular.

These Iguanas live an arboreal life in tropical America and the West Indies, and are often brought to Europe, and kept in zoological gardens and menageries. Climbing with ease and moving with great rapidity amongst the foliage, they do not hesitate to take to water, the neighbourhood of which they usually seek. They swim with ease, entering water voluntarily, and they do not then use their fore limbs, but principally the tail. Brown, in his travels in Guiana, noticed the Iguana on the trees overhanging the rivers, and that they were greatly alarmed at the noise of the boat's paddles. They threw themselves from the branches into the water, many coming down broadside on the surface. Harmless things, they still will show fight, and the lash of their tail gives pain. Their food is not confined to vegetable diet, and as they have a row of teeth on the pterygoid bones, they can readily capture and swallow small grubs and insects. Nevertheless, the insectivorous diet is the most usual, although the blade-like serrate teeth are suited for biting leaves.

The body of each vertebra is procœlous, that is to say, hollow in front and convex behind, the hollow of one vertebra fitting into the convexity or ball of the one in front of it. The arch of bone of each vertebra through which the spinal cord passes is attached to that of the vertebræ in front and behind, by the ordinary oblique articular processes, which permit of a certain amount of motion of the individual bone between its neighbours,† and of a general amount between all the vertebræ. In order to prevent dislocation during rapidly complicated or contorted movements an additional structure is provided, whose use, however, is not so apparent in the Iguana as it is in the Serpents. There is a projection on the front of each arch which fits into a pit on the hind face of the preceding arch,‡ a peg-and-socket joint being formed.

It is remarkable that in all the Iguanidæ of the New World the teeth are pleurodont. But there are others in which the teeth are acrodont, and their possessors are inhabitants of the Old World, the great Asiatic Islands, and Australia. The habits of all are much alike.

A fine Cyclura§ lives in Cuba, which has a back crest, an extensible throat, and a very long compressed tail with rings of spiny scales, and the Crested Anolis‖ has the digits enlarged and united at their base, and the throat sac is very extensible. It has none of the glandular structures in the fold of the thigh which are seen in most of the groups.

The most curious of all these American Iguanidæ is called the BASILISK,¶ and might be taken for an heraldic rather than a real and living active tree Lizard. If it were twelve feet in length instead of as many inches it would not be unlike a mediæval Dragon without wings, and even in its small development it looks very uncanny. Its broad and rather sharp-pointed scaly head has a tall cap-like crest sticking up and back from the hinder part. A tall, thin, fin-like movable crest with spines on it passes along the back, being highest over the loins, and there is a corresponding one on the top of the long tail. The body is scaly and marked in zigzag. There is a very marked fold of the skin on the throat, and the hind digits are fringed at their sides. It inhabits Central America.

The genus AMBLYRHYNCHUS is represented in the Galapagos Islands, and the information about its species is due to Charles Darwin, who writes in his celebrated Journal:—"This Lizard** is extremely common on all the islands throughout the Archipelago. It lives exclusively on the

* *Iguana tuberculata.*

† These articular processes are called *Zygopophyses.*

‡ They are called *Zygosphene* and *Zygantrum.*

§ *Cyclura carinata.*

‖ *Anolis occipitalis.*

¶ *Basiliscus mitratus.*

** *Amblyrhynchus cristatus.*

rocky sea-beaches, and is never found—at least, I never saw one—even ten yards in shore. It is a hideous-looking creature, of a dirty black colour, stupid and sluggish in its movements." The usual length of a full-grown one is from a yard to four feet, and they may weigh twenty pounds. These Lizards were occasionally seen some hundred yards from the shore swimming about. And when in the water the animal swims with perfect ease and quickness, by a serpentine movement of

BASILISK.

its body and flattened tail, the legs, during this time, being motionless, and closely collapsed on its sides.

Mr. Darwin writes also:—"Their limbs and strong claws are admirably adapted for crawling over the rugged and fissured masses of larva, which everywhere form the coast. In such situations a group of six or seven of these hideous reptiles may oftentimes be seen on the black rocks, a few feet above the surf, basking in the sun with outstretched legs. I opened the stomach of several, and in each case found it largely distended with minced sea-weed, of that kind which grows at the bottom of the sea, at some little distance from the coast." It is very remarkable that these Sea Lizards should object to be driven into the water, but such is the case.

A species of the genus leads a terrestrial life on the same islands, and is the *Amblyrhynchus subcristatus* (Gray). This species, writes Mr. Darwin, "differently from the last, is confined to the central islands of the Archipelago, namely, to Albemarle, James, Barrington, and Indefatigable. To the southward, in Charles, Hood, and Chatham Islands, and to the northward, in Towers, Bindloes, and Abingdon, I neither saw nor heard of any. It would appear as if this species had been created in the centre of the Archipelago, and thence had been dispersed only to a certain distance. In the central islands they inhabit both the higher and damp, as well as the lower and sterile parts; but in the latter they are much the most numerous. I cannot give a more forcible proof of their numbers than by stating that when we were left at James Island we could not for some time find a spot free from their burrows on which to pitch our tent. These Lizards, like their brothers, the sea kind, are ugly animals, and are a little smaller."

The second division of the family of Iguanidæ relates to those Iguana-like creatures which have

AMBLYRHYNCHUS CRISTATUS.

acrodont teeth, that is to say, the teeth are placed with their bases on the top of the jaw-bones without sockets. They are nearly all inhabitants of the Eastern hemisphere and of Australia. One of the most interesting is a little representation of the Dragon of the mediæval Eastern imagination. There are many species of these "Dragons,"* but they are restricted to the East Indies, and they are more numerous in the Archipelago than in the Continent. They have not yet been found in Ceylon. The character, according to Günther, by which the FLYING LIZARDS may be at once recognised, is the peculiar additional apparatus for locomotion, formed by the prolonged five or six hind ribs, which are connected by a fold of extensible skin, the whole forming a sub-semicircular wing on each side of the body. They have a long, pouch-like, downward projection of the skin from the throat, and a small horizontal fold sticking out on each side.

They live in trees, jumping from branch to branch, and expanding their back-parachutes. They move rapidly and safely over some distance. When running along a branch, or resting, the back folds of skin are laid backwards along the flanks. They run but seldom, but jump and leap vivaciously. The skinny appendages of the throat are merely appendages of the skin, and may be compared with the wattles of birds: they are not hollow, but they are connected with the hinder horns of the hyoid bone, and can be erected or spread out when the animal is excited by rage. The

* *Draco volans.*

trunk is rather slender, and is covered above and below with very small keeled scales. Large spaces on the parachutes are naked and separated by stripes of minute scales. The tail is long, slender, tapering, and not breakable. The hands are slender, and each has five long, thin, clawed toes. It is said that the transcendent beauty of their colours baffles description. As the Dragon lies in shade along the trunk of a tree, its colours at a distance appear like a mixture of brown and grey, and render it scarcely distinguishable from the bark. Thus it remains with no signs of life, except the restless eyes watching passing insects, which, suddenly expanding its wings, it seizes with a rapid leap. The outer part of the upper surfaces of the "wings" is ornamented with large irregular black dots on an orange or rose-coloured ground, fringed with silver. Besides this, the structure of the wing produces iridescent tints, and they flash as they move through the air from branch to branch. The throat and sac are bright yellow, dotted with black, and the side folds are silvery, rose, or yellow. Below the wing are light brown or black spots. This colouring applies to the description of the common species of Java, Sumatra, Borneo, Penang, and Singapore. The spotted Draco, with the lower part of the wing whitish, with sometimes an isolated black spot, is continental, having been found in Siam; and *Draco dussumieri* is the kind found in the forests of the west coast of Hindostan.

Mr. Moseley noticed the habits of this Flying Lizard in the Philippine Islands. They frequent the lower trees. They spring from tree to tree, and from branch to branch, but they pass through the air so quickly that the extension of their parachute is hardly noticed during the flight. He states:—"We had several of them alive on board the ship for a day or two, where they flew from one leg of the table to another."

The Frilled Lizard* is one of the remarkable Australian animals which, whilst possessing the structures common to others found elsewhere, have a peculiar and almost anomalous conformation. Mr. A. Cunningham, in his Journal on "Australian Discovery under Capt. Parker King, F.R.S.," describes the capture of the first specimen, which was taken off a branch of a tree, in Careening Bay, Port Nelson:—"I secured a Lizard of extraordinary appearance, which had perched itself upon the stem of a small decayed tree. It had a curious crenated membrane, like a ruff or tippet round its neck, covering its shoulders, and when it was expanded, which it was enabled to do by means of transverse slender cartilages, it spreads five inches in the form of an open umbrella. Its head was rather large, and the eyes, whilst living, were rather prominent; its tongue, although bifid, was short and thick, and appeared to be tubular." Captain King stated that the colour of the tongue and inside of the mouth was yellow. The frill arises from the hinder part of the head, and is attached to the sides of the neck and extends down to the front of the chest. It is supported above by a lunate cartilage arising from the hinder part of the ear, and in the centre by a bone which extends about half its length, and is a prolongation of the hyoid. There are four plaits in the frill, and the front edge is serrated; the outer surface has keeled scales, and the inner is quite smooth. The colour of the long-tailed creature is yellowish-brown variegated with black. It has long toes which are very unequal, and the claws are hooked and horn-coloured.

The next family of the Crassilingues contains those thick-tongued Lizards which are terrestrial and not arboreal in their habits, and which have the body broad and flat and the skin covered more or less with spiny scales. They are principally dwellers in deserts and sandy places, but some are found in damp situations, and are called the Agamidæ. One group is restricted to the Old World and Australia, and another to the New World. They differ in the position of the teeth, those of the Old World being acrodont, and those of the New World pleurodont, but it is very remarkable that some of the genera of the one hemisphere should be represented in the other by forms which resemble them in many points of structure and habits.

THE TERRESTRIAL AGAMIDÆ OF THE OLD WORLD AND AUSTRALIA.

The Thorn-tailed Agamas form the genus Uromastix, and they have the body clothed with small scales and a large flattish tail ornamented with rings of large spiny scales, which contrasts with the rest of the rather smooth body. The Dabb, or Dhobb,† of the Arabs is one of them, and is at least

* *Chlamydosaurus* (King). † *Uromastix spinipes.*

FRILLED LIZARD.

a foot in length, and it appears to have a very wide distribution over the desert tracts of Palestine, North Africa, and the sides of the Red Sea.

Only one kind of this genus Uromastix lives in India, inhabiting rocky plains, and reaches some thirteen inches in length. It is found in Western India and not in Bengal.

In Bushire, Major St. John found these Lizards sitting outside their holes in the evening, and a British terrier with him killed two, one of which had attacked him. They are generally very gentle, and are vegetable feeders, possessing a long intestine.

The extraordinary prickly-looking Lizard of Australia, which is called the Thorn-devil, or Horrible Moloch,* belongs to this group, and is about six inches or less in length. Its little head is horned with prickles of large size, and rows of them exist on the bulged-out body. They are on the tail in crests, as it were, and on the limbs.

There is a North African genus of this group which extends into Western Asia. One of the species is from Afghanistan,† but the commonest one found in Egypt is spineless, and the scales of

DABB, OR DHOBB.

it are small, there being no pores on the inside of the thighs. It is interesting from the habit which it has of puffing out its body so as to enlarge its dimensions, and from the gift of being able to change its colour even more promptly than the Chamæleons.‡

A fine Lizard, known to the ancients, belongs to the genus Stellio. In Egypt§ it attains the length of more than two feet, and it has a flat swollen body, and the tail is ringed with scales which are spiny on the tip of it. A dweller in the desert and rocky districts, it is also an inhabitant of Palestine, and is said even now to extend into Turkey and the Islands of the Ægean, and possibly it is found in Cyprus.

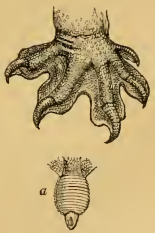
The next group of the terrestrial Agamids is essentially American. In their shape and habits these large and squat-bodied Lizards resemble those just noticed from the Old World and Australia, and the first of them to be noticed—as the Toad Lizards—are closely allied in structure and method of life to the Moloch of Australia. One of these, called the Tapayaxin,‖ is very toad-like in the shape of its

* *Moloch horridus.* † *Trapelus megalonyx.* ‡ *Trapelus ægyptiacus.* § *Stellio spinipes.*
‖ *Phrynosoma orbiculare.*

body; its head is very short, rounded in front, square, and about as broad as high: the neck is short and the tail is short and pointed. It is not as prickly as the Moloch, but there are eight sharp radiating spines on the back of the head, and rows of scales keeled and spined on the flanks. The head is of a red-brown colour, yellowish beneath, spotted with brown, more or less, and the upper part of the body is of a dull sand tint or leathery colour. There is a large brown spot on each side of the throat,

MOLOCH.

and the back is spotted with the same colour, and the spines are brownish. The length of this very ugly reptile is under six inches. It appears to live on insects, and to inhabit the hill country of Central Mexico. Another kind, of which a specimen was in the Zoological Gardens, is the Horned Lizard,* which comes from Texas.



TOES OF GECKO.
(a) Under surface.

THE GECKO FAMILY.—THE ASCALABOTES, OR GECKOTIDÆ.

Curiously-shaped thick-bodied Lizards, with clawed, flattened-out toes, running up straight walls and hunting spiders inside houses, were common objects of natural history to the Greeks, and Aristophanes, and Theophrastus called them ἀσκαλαβώτης, a name perpetuated by Aristotle. They are interesting on account of their very world-wide distribution, for they are found in the hottest parts of the Americas, of Europe, Africa, Asia, Australia, and Oceania, and in several of the larger islands, and this diffusion, insular and continental, together with the amphicœlian nature of the bodies of their vertebræ,† indicates the antiquity of the group.

Species of one genus of the family may be seen in the South of France, and in most Mediterranean countries, and a common kind, which scampers up and down walls, runs along the ceiling, and holds on and turns where the surface is often slippery and upright, belongs to the Platydactyli. It is

* *Phrynosoma cornutum.* † That is to say, they are hollowed out in front and behind.

from four to six inches in length, with a long rounded tail, a flat, plump body, short neck, and each of the rather frog-like limbs ends in five large splay digits, four of which have sharp claws. The head is very broad behind the eyes, which are large, prominent, and have an iris with a vertical slit, and the snout is short. When it runs, which it does with great rapidity, the body is kept low and the limbs are stuck out, and when it moves over upright surfaces, or runs along back downwards, the flat expansion of the toes and fingers, and the minute sharp claws, enable it to cling on where other things, except insects, would fall. The digits are short, and their bones, very equal in length, are so arranged that they fit into the wrist and ankle so as to radiate, as it were, from a common centre to form nearly a complete circle. The great toe cannot separate itself from the others to extend itself backwards. The lower part of the digits is much dilated and widened, and so is the sole generally.

TURKISH HEMIDACTYLE.

This membranous expansion of the skin is furnished with small plates, like scales, following, or overlapping each other in a regular manner, and there is great variety in this arrangement in the different genera and species. Sometimes the rows of plates are continued right across the under part of the digit, one behind the other; in others they are more or less curved, or there may be a longitudinal line separating the continuity of the line, and producing festooning or angulation. In the common Gecko the markings are in simple cross lines. The nails, which pass over the top of the expansion before they become free and terminal, are very movable and cat-like, and assist materially in holding on, by getting into minute crevices and cracks, whilst the expansion itself acts more or less after the fashion of a sucker of the feet of some Insecta. It is certain that the Gecko will remain fixed with some amount of force in antagonism to that of the gravitation of its body.

They can cast loose in an instant, and when the hand is just upon them they vanish, as it were, under the eye of their expectant captor. In some of the family there is considerable membranous fringing of the body, tail, limbs, and digits, and in a Californian kind* these last are almost as much

* *Phyllodactylus tuberculatus.*

webbed as those of a Tree Frog. The Geckos and all the family have the skin loose, and it is not covered with true scales, as in the Common Lizards and most other Reptiles. There are leathery tubercles rounded and sometimes projecting on the skin, and many minute delicate rounded bodies are found in its thickness. But it is usually soft, and its colours may be grey or yellowish, and there are lovely tints of blue, green, and red in some. The males, as a rule, are more brightly coloured than the females, but in both instances the sombre tints allow the prey to be caught readily; for the Geckos will climb to some apparently inaccessible place, wall, tree, or rocks,

FLYING GECKO.

whose colour assimilates with theirs, and will remain perfectly stationary until the unwary insect or spider comes within the range of their attack. Or they will creep out of their hiding-place and pounce upon larvæ, and dig out pupæ from crevices. They are fonder of twilight and nocturnal wandering than moving by day, and they usually feed at night. They have no scaly or leathery eyelids, only a rim of soft lid, but there is a delicate tissue which can be passed over the eyes like a nictitating membrane. The pupil is usually cat-like, and enables the Gecko to hunt by day and night, but in some genera it is round, and eminently adapted for purely nocturnal vision. The tongue is, of course, a short thick one, very slightly forked in front; and as it moves it can drag up the glottis to the palate, so as to form a clicking or clucking sound, something like the word *gek, geko*. Hence the name of the genus and family. The teeth are numerous and pleuro-

dont, that is to say, they are placed in a furrow on the internal edge of the jaws, the roots adhering to the bone by their outsides and below. No teeth are found on the palate, and the creatures catch their prey with their jaws and teeth, and bolt it whole. All the family are harmless, active little things, but popular ignorance and superstition have given them very bad characters, and they are said to produce eruptions of the skin if they run over anybody with their soft, flabby, viscous little toes.

One of the French Geckos belongs to the genus Platydactylus, which is also represented in Spain,* and has the fourth and fifth digits only clawed, but the others of the genus in China, Egypt, and some other places on the Continent have only one digit without a claw.

All the Geckos are fierce, and love fighting, and rob each other, if possible, of their prey. They are carnivorous, and will kill and eat their smaller fellows, and even their own and others' tails fall victims. They will come to be fed at appointed times if some care is taken.

A species which has claws projecting beyond all its thick expanded fingers is found in the hotter districts near the Mediterranean Sea. The scales on the under part of the tail are not unlike those of Serpents, and the underneath part of the disc-like digits has the little plates separated by a middle line. The wart-like tubercles on its skin, and the nature of the clawed fingers, have given it the name of the *Hemidactylus verruculatus*. It is also known as the Turkish Hemidactyle.

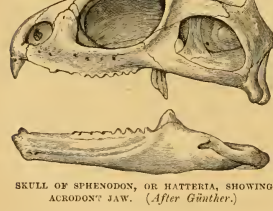
The Common East Indian Gecko is very widely distributed in British India, Siam, Cochin China, and Southern China, and in the Archipelago. It is not found in Ceylon.† It has the habits of the family, but it springs on to its prey like a little Carnivore.

The Flying Gecko‡ is a very handsome kind, of some seven inches long, and is found in Java and in a few other islands of the Archipelago. The expansions of its skin have the same purpose as the corresponding structures of the Dragons and Flying Squirrels. In leaping they are expanded by the pressure of the air from below, and act as a parachute, and when the creature is at rest they are kept in close contact with the body. Cantor says that these Geckos have some power of colour changing.

SUB-ORDER RHYNCHOCEPHALA.—THE BEAKED LIZARDS.

THE TUATÉRA, OR HATTERIA, OR THE SPHENODON LIZARD.

This remarkable reptile from New Zealand was first mentioned in a diary by Mr. Anderson, the companion of Captain Cook, but Dieffenbach gave the first coherent narrative about it (1843):—"I had been apprised of the existence of a large Lizard which the natives called Tuatéra, or Narara, with a general name, and of which they were much afraid." He did not find it so common; and from all he could glean, it appears that it was common formerly in the islands, lived in holes, often in sandhills near the shore, and that the natives killed it for food. Owing to this latter cause, and no doubt to the cultivation of pigs also, it is now very scarce. The specimen he had was extremely sluggish, and could be handled without any attempt at remonstrance or biting. This Lizard has a large head and a great eye, and a crest of separate, white, flat, sharp spines.



SKULL OF SPHENODON, OR HATTERIA, SHOWING ACRODONT JAW. (*After Günther.*)

We owe to Dr. Günther a magnificent description of the anatomy of the Sphenodon and its comparison with the extinct reptiles of the ages of the Trias, which are called Rhynchosaurus and Hyperodapedon. It is an acrodont, and the teeth are so united with a sharp edge of the maxillary and palatine bones as to appear mere projections of them. These edges are, as it were, hard and polished, and are used as cutters when the teeth have worn off. The pre-maxillary bones have a beak-like form, and their large teeth (notched at the crown) become fused with their substance, and somewhat resemble those of a Rodent in shape. There is a remarkable row of teeth on the palate-bone, and the teeth of the lower

* *Platydactylus fascicularis*, known as the *Gecko des murailles*.
† *Gecko guttatus*.
‡ *Ptychozoon homalocephalum*.

jaw bite in between it and the row of the upper maxillary teeth, in a long groove. By friction during some years of mastication these three sets of teeth become worn, so that those on the lower jaw, or mandible, are ground to an edge, and the others on their inner and outer faces respectively. There is great solidity of the large skull at the jaw-joint, and the quadrate bone is fixed to the side of the head, whilst the squamosal, quadrato-jugal, and pterygoid bones are (unlike in all other Lizards) united by bone. Moreover, they are strengthened by the ossification of a membrane which, in Lizards, extends between the quadrate, the pterygoid, and the skull, and bounds the front walls of the cavity of the ear. The bodies of the vertebræ are hollow in front and behind, and there is a remarkable system of sternal and abdominal ribs. These Lizards appear to eat large insects and small ground birds.

THE SUB-ORDER VERMILINGUES.—THE CHAMÆLEONS.

The Lizards of this sub-order are most remarkable in their appearance, anatomy, physiology, and habits, and the well-known Chamæleon, so grotesquely formed, and so changeable in its colours, is the type of the only family of it—the *Chamæleonidæ*.

The species are numerous, and are found in Southern Europe, Africa, Asia Minor, Hindostan, and Ceylon. There are no less than twenty-one species in Madagascar. Lately it has been proposed to form them into two genera, one of which is Chamæleon and the other Rhampholeon.

The Chamæleon has been thus termed after its curious designation by the Greeks. They called it χαμαιλέων, or Small Lion, and yet a more significant name might have been given to it, for Aristotle described the strange creature with his usual great accuracy. It is one of the most extraordinary looking things in Nature, and its flattened body is surmounted by a crest of toothed skin on the thin back. The neck is creased, and the head is triangular in outline, having a pyramidal top. The eyes are large and glaring, and look in different directions, being, moreover, covered with skin except in their centre. The ears are not visible, and the mouth is a slit. A long, compressed, pointed, prehensile tail is usually twisted around some object by way of safety, and the fore and hind feet have digits divided into fore and aft sets, and they clasp their supporting bough very much after the fashion of some birds. The skin is soft, knobbed, or tubercular, lax on the creature, and is like a minutely scaly shagreen, and its colour changes in a very remarkable manner. Usually very still, slow, and quiet in their movements, the Chamæleons can suddenly protrude an extremely long, fleshy, cylindrical, worm-shaped tongue, with a curious lobed cup-shaped end, and thus catch insects with singular rapidity and certainty. Indeed, it is the most active part of the animal, which, usually hidden up under leaves, or on boughs much resembling it in colour, does not chase its prey, but watches and waits until an insect comes within the length of half of its body and tail, and then suddenly it protrudes its long tongue, and the victim is stuck fast to it by a viscid secretion. When the tongue is withdrawn it brings the insect into the mouth, and it is then packed away in a groove in the hard palate. The teeth are acrodont in position. The position of the body is high on its legs.

HEAD OF CHAMÆLEON, SHOWING THE TONGUE.

The lungs are of great size, and the front costæ unite with each other on the rudimentary sternum, and the others, including those of the loins, complete their path around the abdomen. This permits of the extraordinary size and expansion of the lungs at the will of the animal, by which, filling itself with air, its outside tissues become, as it were, transparent. This enlargement of the cellular structure of the lungs passes air into air-vessels distributed about the body, and increases the size and plumpness of the creature, which can be diminished rapidly when the air is expelled.

The Common Chamæleon is found in Southern Spain, and the north and south of Africa; also in Asia Minor, many parts of Hindostan, and in the northern parts of Ceylon. Most of the Indian specimens are of a green colour, uniform, or irregularly spotted and banded with dark green or brown, whilst in African specimens the ground colour is greyish-olive, yellowish, or brownish. The "grains"

CHAMÆLEON.

of the skin are equal and close, and the crest on the upper part of the body is toothed as far as the middle of the back, and that on the lower part, as far as the vent.

There are many species or varieties of Chamæleons in Africa besides the common one.* The Island of Madagascar has a vast number of them included in several species, and probably one-third of those known are found there. One of them is called the Rhinoceros Chamæleon, from the male having a horn-like tubercule at the end of the muzzle. Another, described thence by Günther, has a tail which is so short that it cannot be used as a prehensile organ,† but this is compensated for by the presence of an additional projection at the inner base of each claw, and of a spine projecting from the side of each finger and toe, structures which add to its powers of clasping and holding on. The Three-horned

* *Chamæleon vulgaris.*

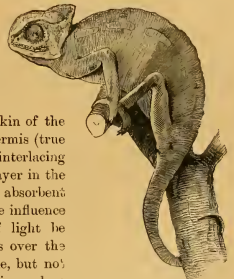
† Forming the genus Rhampholeon (*Rhampholeon spectrum*).

Chamæleon* is from Fernando Po, and the male has a long horn over each eye, and another at the end of the muzzle. Günther's *Chamæleon montium* has its male with two nearly straight horns projecting horizontally in front of the nostrils, and their sheath is finely annulated; the horns are half as long as the head. It has a high crest on the back and part of the tail. In the female the horns are mere projections. The colour is a mixture of yellow, green, and black. With regard to the habits of the small South African kind, and to its viviparous nature, Moseley writes in his "Notes on the *Challenger*":—"A small Chamæleon is abundant everywhere on the hedges near Cape Town, South Africa. We had one alive in the ward-room; it was quite tame, and rested quietly on a bunch of twigs, hung up to the lamp rail, and would whip flies out of one's fingers, at a distance of at least four inches, with its tongue. It gave birth to three young ones one night. They twisted their tails round the twigs on which the mother was reposing, at once, and directly began catching flies; but our house-flies were too big for their mouths to swallow, and they had to chew away at them for a long time before they could get any juice out of them." Most species lay eggs under leaves.

SLEEPING CHAMÆLEON UNDER LAMP-LIGHT, WITH DORSAL PART PROTECTED BY A SCREEN.
(*Unprotected portion in this experiment is of darkish green colour; protected portion appears like a brownish saddle.*)

The changing of the colour of its skin by the Chamæleon has made the curiously-shaped reptile most interesting. This power is not restricted to them, however, but they possess it above all other reptiles and amphibians. The change of colour appears to be produced to a certain extent by the will and passions of the Chamæleon, by an involuntary habit which enables its tints to correspond with the natural substances on which it is placed, and also to have some relation in certain cases to the sun's rays. The skin, so readily stretched and inflated by the enlarging lungs, may be rendered thin, transparent, and some of it more vascular than the rest.

There are minute corpuscles of different colours in the skin of the Chamæleon, which are sometimes hidden in the depths of the dermis (true skin), and sometimes spread out on its surface layers in a kind of interlacing network. There is also a yellow colouring-matter, and a bluish layer in the skin becoming yellow by transmitted light, and blue on an absorbent ground. Now, during sleep, or if the reptile is placed under the influence of chloroform, the whole body becomes yellowish-white. If light be allowed to fall on the reptile thus situated, a dark tint comes over the skin. The light coming through dark blue glass does the same, but not through red and yellow glasses. Sections of nerves and of the brain produce remarkable changes in colour, and it appears to be the case that the various colours and tints assumed are due to the change of position of the coloured corpuscles which, according as they bury themselves under the dermis, or form an opaque ground beneath the cœrulescent layer, or spread out a superficial ramification, either leave the skin its yellow colour, or give it green and black colours. The movements of the corpuscles are governed by two kinds of nerves, some of which cause them to travel from its depths towards the surface, while the others produce the opposite effect. When greatly irritated these corpuscles conceal themselves beneath the true skin. This is also the case in sleep and death and anæsthesia.



CHAMÆLEON UNDER SUNLIGHT PASSING THROUGH RED AND BLUE GLASS, LIGHT PASSING THROUGH RED GLASS FALLING ON FORE PART OF BODY, AND THAT PASSING THROUGH THE BLUE ON THE HIND PART.
(*In this experiment the body seems to be divided into two parts, the anterior of a clear green with no spots, the posterior of a darkish green.*)

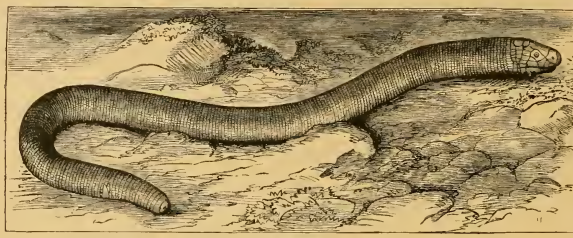
* *Chamæleon owenii.*

It is evident that the luminous rays belonging to the blue-violet region of the spectrum act directly upon the contractile matter of the corpuscles, causing them to move and approach the surface of the skin.*

SUB-ORDER AMPHISBÆNOIDA.

The White Amphisbæna,† which may be considered the type of this remarkable group, is a snake-like animal, without arms or legs, and these the natives suppose it was born with and has lost. The word is from the Greek ἀμφίβαινα, which means an animal that can walk in both directions, and the reptiles can move forwards or backwards with their very worm-like bodies. They are not Snakes, however, but really belong to the Lacertilia.

The White Amphisbæna, or Ibijara, is a Brazilian kind, and has the cylindrical worm-like body of the group, being about as thick as one's finger, the head and tail not being distinguished



WHITE AMPHISBÆNA.

readily by careless and frightened observers. It grows to the length of one foot six inches, or to one foot nine inches, the tail, or that round part behind the vent, being from an inch and a half to two inches only in length. On looking at the body, a great number of rings of hard, glassy-looking skin, made to look scale-like by markings in regular longitudinal lines, are seen. The result of the markings and disposition in rings is to produce a mosaic of quadrangular false scales, and they are very equal in size; and after skin-shedding has taken place are glossy and rich in tint. The mouth is small, the muzzle is round, and the head is rather flat on the top, and there are two large separated nasal plates and two pairs of frontal plates behind them. The eye is very small, and covered with thin skin, and the limbs are deficient. Burrowing easily in the ground and in ants' nests, the Amphisbæna preys on small things, and has a short thick tongue without a sheath. The genus Blanus has a more worm-like species than Amphisbæna.

One of this sub-order has a very small pair of arms with four digits, situated just behind the head, but there are no legs. This is called *Chirotes canaliculatus*, and is about eight to ten inches in length, and as thick as the little finger. It appears to burrow, and to live on insects in its worm-like life. In these Amphisbænoida the vertebræ are procœlous, and there is no sacrum, and all the vertebræ in front of the tail, except the one or two nearest the skull, have ribs. Their internal anatomy is more like that of the Chamæleons than any other group.

SUB-ORDER BREVILINGUES.—THE SCINCOIDÆ AND ZONURIDÆ.

Some of these might readily be taken for Lizards, and others for Snakes, so variable is the shape. They are a harmless set of beings, some having, however, undeservedly very bad reputations.

* It is a point of some importance to recognise that the hemispheres of the brain, by the intervention of the involuntary (reflex) nerves, govern the colour-deciding nerve—those which move the corpuscles—and it would appear that this involuntary action relates to what is seen by the eye of the opposite side of the body.

† *Amphisbæna alba.*

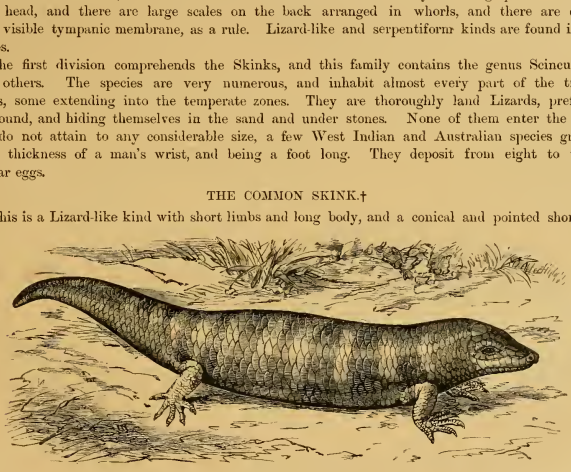
They are not venomous, and some live above and others much under ground, preying on worms and insects. Some of them are to be found in every part of the tropics, and in some parts of the temperate zones, but certain genera are restricted to particular regions. They are called Scincoids. Those Scincoids which resemble Lizards more than Snakes have fore and hind limbs ending in hands and feet furnished with five digits, which are clawed. The serpentiform kinds have no limbs visible; and between them and those just alluded to are kinds with only the rudiments of the hinder limbs. Some of these have no toes, and others have two toes on the ill-developed feet; and there are a few with fore and hind limbs, but without their extremities. A smooth, scaly outside hides, even in the kinds where no limbs exist, imperfect and rudimentary shoulder and pelvic girdles of bone or cartilage. When limbs are present these bones are well developed, for instance, in the Lizard-like kinds. Some have very sharp eyes, and one or more well-grown eyelids; others have the eyes very small and covered and hidden by skin; and a few have very small or no eyelids. Those with well-developed and movable eyelids have the opening of the tympanum visible, but in the others it is covered up. Whether the body is furnished with limbs, or is worm- or snake-like, there are always large scales or plates on the fore-part of the head, arranged symmetrically; and the body and limbs are covered with scales, which may overlap or not. They all have a short, thick, very slightly extensible tongue, which is flat, and more or less notched in front where it is thinnest. It is often scaly, or covered with scale-like elevations, and has no sheath.

As a sub-order of the Lacertilia, these creatures may be divided into two families. One* contains those whose general description has just been given; and the other includes the kinds which have an extensible fold of skin on each side of the body, furnished with small scales, and which reaches from the ear to the vent, and divides the back from the abdomen. They have large plates on the top of the head, and there are large scales on the back arranged in whorls, and there are eyelids and a visible tympanic membrane, as a rule. Lizard-like and serpentiform kinds are found in both families.

The first division comprehends the Skinks, and this family contains the genus Scincus, and many others. The species are very numerous, and inhabit almost every part of the tropical regions, some extending into the temperate zones. They are thoroughly land Lizards, preferring dry ground, and hiding themselves in the sand and under stones. None of them enter the water. They do not attain to any considerable size, a few West Indian and Australian species growing to the thickness of a man's wrist, and being a foot long. They deposit from eight to twelve globular eggs.

THE COMMON SKINK.†

This is a Lizard-like kind with short limbs and long body, and a conical and pointed short tail.



COMMON SKINK.

The head is small for the stout neck, and is wedge-shaped; the muzzle is flat, and the upper jaw is long, and the eye has a lower lid which is not scaly. On looking at the extremities, the four feet

* *Scincoidæ.* † *Scincus officinalis.*

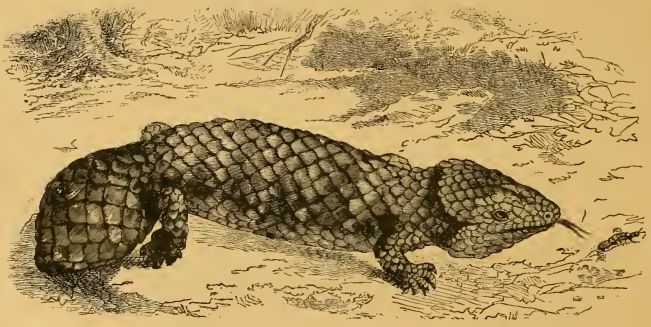
will be seen to be furnished with five clawed scaly endings. They are flat and saw-like at the edges, a large scale being over the base of the nail.

The Skink inhabits the western and northern parts of Africa, and they are found also in Senegal, in Abyssinia, on the other side of the Continent, and in Egypt, and Bruce met with it in Nubia. It likes a warm place, and frequents the little hillocks of fine and light sand that the wind accumulates at the foot of hedges that border the cultivated lands, and of the tamarisks which try to vegetate on the confines of the desert. There it may be seen comfortably basking in the rays of the burning sun, and chasing, every now and then, the beetles which crawl within its range. It runs very quickly, and, when menaced, buries itself in the sand with great rapidity, hollowing out for itself a burrow many feet deep in a short time. When taken it endeavours to escape, but does not attempt to bite or to defend itself with its claws. Probably they attain five inches in length.

This little creature was once of use to the physician, although of doubtful value to the patient. It was dried and powdered and given as a remedy, or specific, against almost every malady, by the Greeks and Romans. Pliny wrote that the scales of the nose and the feet, after being powdered and boiled in white wine, were to be used as particular stimulants; and Apelles used parts of the animal as antidotes against the wounds inflicted by poisoned arrows. Up to the sixteenth century the reptile led an unhappy life, being chased, and taken, and swallowed; but gradually its medicinal virtues were disproved, and it now lives in peace.

A Scincoid* which lives in the New World has its head of a bright-red colour, and the body and tail are olive; the throat and abdomen being yellowish-white. It is about thirteen inches in length, and is found from lat. 39° N. to the Gulf of Mexico, in the Atlantic States, as well as in Mississippi and Louisiana. It frequently takes up its abode in an old nest of the Woodpecker, out of which it thrusts its head in a threatening manner. Seldom coming to the ground, it is shy, but fierce when taken, and bites severely.

Australia has some remarkable Scincoids, and one, which is called the Stump-tailed Lizard,† is very curious from the extraordinary resemblance which the tail bears to the head when the eyes are closed with their scaly lids. Visitors to the Zoological Gardens frequently say that the



STUMP-TAILED LIZARD.

creature has two heads, when it is motionless, in its cage. It has a long stout body and blunt head and tail, four small limbs and short digits. The body in its upper part, and the head and tail, are encased in large, rough, broad scales. The lower eyelid is minutely scaly, and the eye is bright, of a brown colour, with splashings of yellow occasionally. Underneath the body the scales are smaller and lighter-coloured, and the ear is not visible.

* *Plestiodon erythrocephalus* = *Scincus americanus.* † *Trachydosaurus rugosus* (Gray).

It is very common in some parts of Australia, for instance, in Western Australia, particularly in the neighbourhood of King George Sound, but they do not inhabit the east coast; at all events they are not found near Sydney.

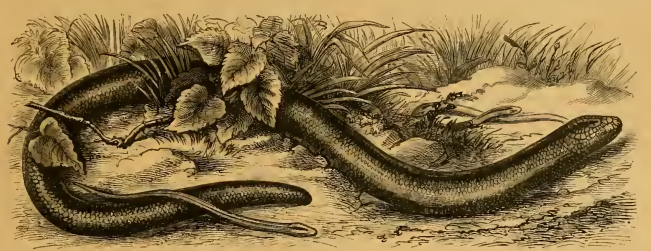
It is generally known as the "Sleeping Lizard," and it frequents open, sandy plains, and may be captured in large numbers on a hot summer's day.

The number of young produced seldom exceeds four.

The large Australian Lizards, with broad crushing spheroidal crowns to their teeth instead of sharp points, belonging to the genus Cyclodus, are allied to the last-mentioned kinds, and have many curious structural arrangements in common. They are the Great Cyclodus from Australia, which breeds in the Zoological Gardens of London, and the Black-and-yellow Cyclodus, from Tasmania.*

GENUS ANGUIS.—THE BLIND-WORM, OR SLOW-WORM.†

The late Mr. Thomas Bell, in his interesting book on the "British Reptiles," states that the Blind-worm, or Slow-worm, is found in almost every part of Europe, excepting the extreme north,



BLIND-WORM.

and is capable of enduring a much colder climate than most other reptiles, even that of Britain. It is found in Russia, Poland, Denmark, Sweden, and Scotland, as well as throughout the more temperate parts of Europe as far as the South of France and Italy, but it has not been seen in Africa. It is worm-like in shape, long, and almost of equal thickness throughout, but it tapers slightly at the tail end. The teeth are very small, and are slightly hooked. The tail is not more than half the length of the body in some individuals, but it is longer in others. It may reach from ten to fourteen inches in length, and the head measures half an inch or more. The general colour is brownish-grey with a silvery glance, and there is a dark line down the back. The history of one is given in White's "Selborne:"—"A Blind-worm that I kept alive for some weeks would, when touched, turn and bite, although not sharply. Its bite was not sufficient to draw blood, but it always retained its hold until released. It drank sparingly of milk, raising the head when drinking. It feeds upon the little white slug so common in fields and gardens, eating six or seven of them one after the other, but it did not eat every day. It invariably took them in one position. Elevating its head slowly above its victim, it would suddenly seize the slug by the middle, in the same way that a ferret or dog will generally take a rat by the loins. It would then hold it thus sometimes for more than a minute, when it would pass its prey through its jaws, and swallow the slug head foremost. It refused the larger slugs, and would not touch young frogs or mice. The Blind-worm avoided the water, and was a remarkably fine one, measuring fifteen inches in length." They are very timid when first caught, and they contract their muscles so forcibly that they become stiff, and it is when in this rigid condition that the body is easily broken in two by a blow, or by an attempt to bend it. Hence the name fragile, or fragilis. The females are ovo-viviparous, there being some-

* *Cyclodus gigas* and *Cyclodus nigro-luteus*. † *Anguis fragilis*.

times from seven to twelve young. The young are very active, and are only from eighteen to twenty lines in length at first, but they grow quickly, and soon learn to eat slugs and insects.

GENUS ACONTIAS.—THE ACONTIAS.*—THE JAVELIN SNAKE.

This is a small snake-like member of the group of Scincoids, more so, indeed, than the Blind-worm and Australian Pygopus, for it has no traces of rudimentary external limbs or of internal shoulder and pelvic girdles. The head, however, is that of a Lizard, and there is only a lower eye-lid. The body is cylindrical and serpent-like, but it is covered only with small scales; and the jaws are not capable of extension, and the teeth are small and conical. The tongue is scaly and slightly notched at the point. These snake-like Lizards are harmless, and endeavour to escape on the least alarm, by hiding under leaves, or even getting down into dry soil like the Blind-worm. They have the appearance of a Snake when still and on the ground, but their method of progression is by carrying the head and front part of the body erect. They have the power of darting suddenly, and in a horizontal direction in striking, and this was magnified in a ludicrous manner by the ancients, who confounded many real Snakes with them, and gave them a very bad character.

The lungs of this creature are not equally developed, one being, as in the Serpents, longer than the other; but the anatomy of the jaws distinguishes them from the Snakes.

Another snake-like creature, not without some resemblance to an Acontias, is from South Africa. It has its eyes hidden beneath the skin, and has a cylindrical body, a short truncated tail, and is of a yellowish tint, reticulated with violet. This *Typhlina cuvierii* has no limbs.

The Pygopus,† a snake-like form, is occasionally met with in Australia, but on the whole it is rare. Its flat tongue, the two flap-like rudimentary limbs near the vent, without toes to them, and its ear-holes, easily distinguish it from a true Snake.

Very little, if anything, is known of its habits; but it is one of the interesting Saurians which has apparently degenerated towards the Serpents. It has rudimentary bones of the shoulder girdle and sternum, and the ill-developed hind limbs project and are visible enough. The length of the Pygopus is about two feet.

THE ZONURIDÆ.

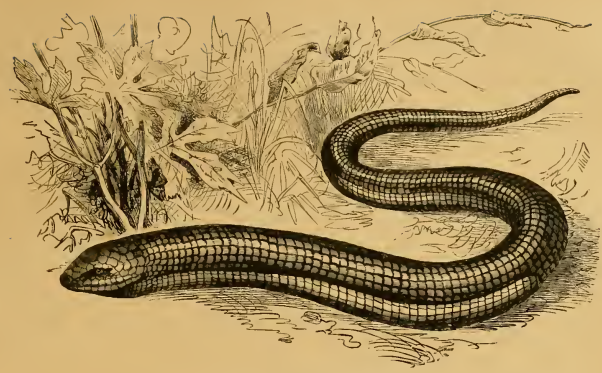
The second family of the Brevilingues contains forms which have the shape of short-limbed, long-bodied, and tailed Lizards, and others which are serpentiform, having only rudimentary hinder limbs. They have a marked peculiarity which relates to their method of life. Their body is covered with scales, which are squarish on the back, and rounder on the belly, but they do not overlap, and are in cross-bands one behind the other, and closely applied. The food consists of worms, insects, small mice, and little reptiles; and certainly it could not be swallowed or comfortably digested were all the cross-bands of the body continuous. The skin is not extensible, as in the other Saurians, and there is a region at the side of the body, where there is a long fold covered by small scales, and this part can be stretched, although the rest is rather rigid. The Lizard-shaped kinds are numerous, and can be best illustrated by considering the genus Zonurus, or Cordylus, which has large head scales, and four limbs with five digits.

The Cordyles of South Africa are very numerous as individuals, and there are many species, some excessively repulsive in appearance, from their ragged, scaly covering, and others less so, on account of their appendages being small and smooth about the body, although those of the tail are mostly spined and keeled.

The Gigantic Cordylus‡ reaches fifteen inches in length, and is therefore large for the group, and it is readily known also from its dark umber-brown sienna and straw-yellow-coloured scales, which are mostly large, and covered with large or small spines, or keeled. The zones or bands of scales on the body are more strongly spined on the flanks, and they are large, distinct, and spiked on the tail. It inhabits the interior districts of Southern Africa, and is not unfrequently seen on the rocky pinnacles of the Quothlamba mountains which separate the country of the south-east coast from that of the interior.

The serpentiform kinds of this division are numerous, and some of them are called Glass

* *Acontias meleagris* (Cuvier). † *Pygopus lepidopodus*. ‡ *Cordylus giganteus* (Smith).



SCHELTOPUSIK (*Pseudopus pallasii*).

Snakes, partly from their very snaky appearance, partly because they are glassy in tint, and principally on account of their brittleness.

The European Pseudopus is a common example, and it is called the Scheltopusik (*Pseudopus pallasii*, Cuvier). It has been found in Central Russia, in Europe, Hungary, and in Dalmatia, and is a dark, chestnut-brown, glassy snake-looking creature, reaching the length of two feet. It has the rudiments of the hind limbs, in which a small femur is hidden, and they have no digits. Internally, there are traces of the shoulder and pelvic girdles, and one lung is a quarter less in size than the other. This species lives on insects, small mice, worms, and frogs.

An American Glass Snake (*Ophisaurus ventralis*), very small, breakable, and limbless, belongs to this group, and has no hind limbs. It reaches twenty-eight inches to three feet four inches in length. It chooses dry places, passes much of its time in holes, and is often dug out of the earth with the sweet potato at harvest time. It moves with considerable swiftness, and is found from Virginia to Cape Florida, and ranges to the Mississippi, and as far as Michigan.

CLASSIFICATION OF THE ORDER SAURIA, OR LACERTILIA, OR LIZARDS.

Sub-Order I. Fissilingues	Family 1. Lacertidæ		Example:	Lacerta agilis (Sand Lizard).
	,, 2. Ameividæ		,,	Tejus teguexin (Teguexin Lizard).
	,, 3. Platynota		,,	Monitor niloticus (Nile Monitor). Heloderma horridum.
,, 2. Crassilingues	Family 1. Iguanidæ.	(Pleurodont)	,,	Iguana tuberculata (Tuberculated Iguana).
		(Acrodont)	,,	Draco volans (Flying Dragon).
	,, 2. Agamidæ.	(Acrodont)	,,	Moloch horridus (The Horrid Moloch).
		(Pleurodont)	,,	Phrynosoma cornutus (Horned Toad).
	,, 3. Ascalabotes		,,	Platydactylus fascicularis (Gecko).
,, 3. Rhynchocephala	Family 1. Sphenodontæ		,,	Sphenodon (Tuatéra). Hatteria.
,, 4. Vermilingues	Family 1. Chamæleonidæ		,,	Chamæleon vulgaris (Chamæleon).
,, 5. Annelata	Family 1. Amphisbænidæ		,,	Amphisbæna alba (the Amphisbæna).
,, 6. Brevilingues	Family 1. Scincoidæ		,,	Scincus officinalis (the Common Skink)
	,, 2. Zonuridæ		,,	Pseudopus pallasii (Scheltopusik).

CLASS REPTILIA, THE REPTILES.

CHAPTER IV.

ORDER OPHIDIA.—THE SNAKES.

THE SNAKES—The Poisonous and the Non-Poisonous—Characteristics of a Snake—Serpent Worship and Superstition—About Fascination—Skeleton of a Snake—Scales and Plates on Head and Body—Moulting—THE POISONOUS COLUBRINE SNAKES—THE POISONOUS TERRESTRIAL COLUBRINE SNAKES—THE COBRAS—The Cobra-di-Capello—The Egyptian Cobra, or Naja—THE RING HALS SLANG—THE HAMADRYAD SNAKE—THE BUNGARUMS AND KRAITS—The Poisonous Elapidæ of Australia and the New World—THE POISONOUS SEA SNAKES—THE VIPERINE SNAKES—Characters—THE ADDER, OR COMMON VIPER—The only Poisonous Reptile in Britain—Habits—Its usual Prey—Its Young—The Horned and other kinds of African Vipers—The Daboia—The Echis—THE RATTLESNAKES, OR PIT VIPERS—The Common Rattlesnake—Its Habits—The "Rattle"—The Water-rattle—Various Kinds of Rattlesnake—Cones on the Use of the Rattle—The Bushmaster—Darwin on the Genus Trigonocephalus—The Water Viper—The Copper-head Snake—The Yellow Viper, or Fer-de-Lance—The East Indian Genera of Pit Vipers—How Venomous Snakes Dispose of their Victims—Peculiar Construction of their Skull for Swallowing purposes—The Fangs and Poison-glands of the Rattlesnake—Symptoms of Poisoning—How does the Poison kill?—Treatment of Bites—Snake-Charmers—THE INNOCUOUS COLUBRIFORM SNAKES—Characters—THE WART SNAKES—THE WHIP SNAKES—Why so called—The Langaha—The Blunt-Headed Snakes—THE TREE SNAKES—THE DESERT SNAKES—THE RACHIODONT FAMILY—An Egg-swallowing Snake—Fresh-water Snakes—THE COLUBRIDES—NATRICINÆ—The Common Snake—Found in England—Habits—How it Disposes of its Food—COLUBRINÆ—CORONELLINÆ—CALAMARIDÆ—THE ROCK SNAKES—Distribution—Huge Proportions—How they Tackle their Prey—The Indian Species—The West African Forms—Pythons Hatching their Eggs—The Diamond and Carpet Snakes—The Boas—The Boa Constrictor—Construction of a Python's Skull—The Anaconda—THE SAND SNAKES—THE SHORT-TAILED SNAKES—THE BLIND SNAKES—Characters—Peculiarities of Structure in Serpents—The Remarkable Eyelid—Fossil Snakes—Classification of the Ophidia—THE EXTINCT REPTILES—THE DINOSAURIA—THE ORNITHOSAURIA—THE ICHTHYOPTERYGIA—THE PLESIOSAURIA—THE EXTINCT SAURIA, OR LACERTILIA.

A LITTLE SNAKE,* with rows of black spots on the back and sides, a yellow splash behind the head, and pale lead or bluish underneath, may be seen now and then in quiet, warm places in England basking on banks in the sun or sliding in or out of a pond. It is often made a pet of, and is harmless to man, although a terror to frogs, but even to them it is not poisonous. It lays eggs. It is the common Harmless Snake. Another one,† found on dry heaths and sandy banks, and amongst low brushwood and thickets, has the neck rather smaller than the back of the head, which is enlarged behind the eyes; and the long body swells to about its middle, and then scarcely diminishes in thickness to near the end, where it becomes abruptly smaller. Its colour may be olive or rich deep brown, or dirty brown-yellow, and there is a zigzag pattern down the sides, and spots of a darker tint. Little ones may be found with it, and it produces the young in the living condition. This is the Viper, or Adder, and it inflicts fatal wounds with its fangs upon small animals like mice, and its poison will imperil the life of delicate and unhealthy men. Common observation can thus separate the Snakes of Great Britain, for there are only these, into two divisions—the innocuous and the poisonous—and this classification holds good for the Snakes of the whole world; and special anatomical characters are found in the last group, making the distinctions all the more obvious and real. Thus in India there are many very pretty Snakes which swallow small living prey, without the teeth introducing a poison, and there are also the terrible Cobras, and many others, which can destroy the life of man, or of large animals, in a few minutes, by the agency of a drop of fluid which enters the wound with the teeth. The same observation is true in Africa and America, and it is found that many of the innocuous Snakes crush their prey in the folds of their long bodies, whilst the poisonous inflict a wound which they seem to know will be fatal, and when the victim is dead, or in its last struggle, it is swallowed whole. Probably there are 1,300 kinds of Snakes in the world thus separable into the harmless and poisonous, or, more properly, into the non-poisonous and the poisonous, for the great Pythons and Boas are dangerous to man by their squeezing and clasping; moreover, they bite fiercely, but do not inflict a poisoned wound.

Many Snakes in tropical climates live a forest life, climbing on and moving amongst the trees, and are usually beautifully coloured. They are long in the body, very active, and are very properly called Tree Snakes. Most of them are not provided with poison fangs, but some have them, so that the great primary divisions of the Snakes are present. But it is found that some of these poisonous kinds are not viviparous like the Vipers or Adders, and they bring forth eggs like the

* *Tropidonotus natrix.* † *Pelias berus.*

innocuous Snakes. Moreover, there are some peculiar anatomical arrangements in them not noticed in the Vipers. Hence, the poisonous Snakes are divided into two groups—the Viperiform Snakes and the Venomous Colubrines—and the innocuous Snakes are the True Colubrines.

A great number of Snakes live on the ground, rarely, if ever, taking to trees. They have a very flexible body, which is more or less cylindrical in shape, and amongst them are Vipers (Viperiform Snakes), venomous Colubrine Snakes, and innocuous Snakes (Colubrine Snakes)—in fact, all the divisions. A few harmless Snakes (Colubrines) live a burrowing life under ground, and have rather a rigid, round body and a small mouth. Finally, there are several kinds of Water Snakes. Those which frequent fresh water are harmless Colubrines, but those which live in the sea are all poisonous, and belong to the venomous Colubrines, and not to the Viperiform division. All have a long, forked, protractile tongue.

On looking at a Snake carefully, taking the Common English Spotted Snake as an example, no difficulty is found in distinguishing the head from the rest, and it is evident that there are no limbs, but what is neck, body, and tail is not at first so readily determined. The neck is, of course, the part behind the head, and it merges gradually into the body, there being no place of division; but the tail, although not very distinguishable on the top of the Snake, is so beneath, for it is placed behind the part from which the evacuations come, and its scales are arranged differently to those in front, they being in double rows, whilst all those of the underneath part of the body are in a single row.

With very few exceptions, the Snakes of all the divisions are covered with scales, and there may be plates on the head. The scales are not bony, but are true skin structures, and they are occasionally shed, new ones appearing. The presence of plates on the head, the arrangement and character of the scales on and under the body and tail, their colour and ornamentation, are all useful in the classification of these reptiles, for they are very persistent characters; if the coloration is excepted, for this is often very variable in the same species in the same country. The shape of the head, and the relation of the size of the body and tail, are also important distinctive characters, and the anatomy of the skull, jaws, and teeth is of the greatest value in the primary separation into great groups.

But although there is no difficulty in distinguishing a Viper, a Boa Constrictor, or a Common Snake from any other animal, it must be remembered that there are some Saurians which closely resemble some of the Snakes. Amphisbæna (p. 294), and Anguis (the Blind-worm), and Acontias and Pseudopus (pp. 298, 299) are Snake-like and have no limbs. On the other hand, it has been found that such great Snakes as the Boas, for instance, and, indeed, all the species of a Snake family (the Pythonides), have minute vestiges of hind limbs, scale-like or spine-like, close to the vent; and this peculiarity recalls to the student the Lizards of the peculiar Australian kind (Pygopus), and the Brazilian Ophiodes. Moreover, amongst the Amphibia, which have not as yet been considered in this work, there is a Snake-like form called Cæcilia. These resemblances are not entirely confined to the outside, for some of the Sauria have one of the lungs ill-developed, the other preponderating, and this is found in all the Snakes. Moreover, although the great majority of the Serpents swallow their food whole, by means of a special mechanism which permits distention of the jaws and throat, some consume such small prey that there is not this gift. And in the absence of this very common characteristic, many of the smaller Colubrine Snakes resemble some of the Snake-like Lizards. But on examining the internal organs, and especially the bony framework of the Snake's body, the distinctness of the order Ophidia from that of the Saurians becomes more and more evident. No Snake has a shoulder girdle, and the eyelids, the covering of the tympanum, and the bladder are wanting.

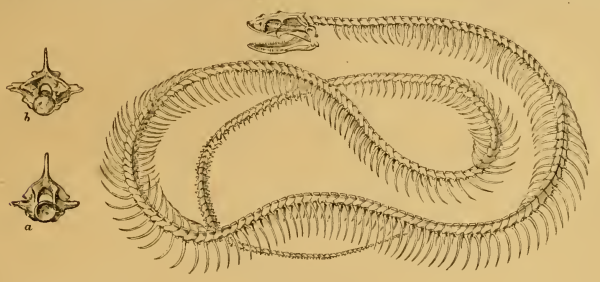
In considering this inability to separate the great groups of Snakes and Lizards by outside characters in some instances, and by some internal ones also, it becomes evident that there is no hard and fast line to be drawn between them. Moreover, study gradually develops the thought that the Snakes, coming late into being in the world's history are, like the limbless Lizards, modifications, by a degenerative process, of reptiles which did not crawl on their belly, but which had those organs in perfection which are rudimentary or absent in the Serpent. Beautiful to look at, glistening often with an iridescence which adds to their mosaic of lovely colours, moving with great grace, apparently with an incomprehensible and determinate will, seizing their prey to crush it and swallow it, or to destroy it by poison in a few minutes, no wonder that early man worshipped these emblems of destruction and death, and gave them credit for wisdom and power.

This belief increased in the days when myths originated, and Serpent worship became as great an institution as that of any other animal, and left its impress on the minds of many generations, thanks to tradition, a peculiar symbolical architecture, and ignorance of natural history. The curative powers of powdered Snakes, of the concretions collecting sometimes in their insides, and of their cast-off skins, were long believed in, and the Serpent became the medical coat-of-arms. Their rapid movements and powers of attack were attributed to the gods, whose messengers of death they often were, and it is therefore not to be wondered at, that during every age when superstition has dominated the Snake was a power. The fascination said to be exercised by Snakes over their prey has formed the subject of many essays, and it is universally credited that under the glance of the Serpent, birds, animals, and even man, are motionless, unable to fly from the glistening evil, and, regardless of danger, do not seek to escape, or fully aware of it, cannot. Snakes in a state of nature and in captivity are different creatures, and the descendants of thousands of generations of animals, all of which have suffered more or less from the Serpent's attack, may have hereditary fear of it. But in the Snake-room of the Zoological Gardens the captive Snakes, and the Rats, Mice, and Birds, unaccustomed to Snakes, do not impress one with the truth of the popular belief. Terror, undoubtedly, may exercise a paralysing influence on the creatures in the way of the Snake; and the parental affection of birds for their young, which causes them to flit about their nest, and to be destroyed with their little ones, is usually but erroneously taken for fascination on the part of the Snake. In fact, an analysis of any instance of fascination shows it to be supposititious.

A Snake when on the ground moves often with considerable rapidity. The head is slightly raised, and the body and tail progress by means of the peculiar grasping power of the skin and ribs of the underneath parts, which enables consecutive contraction and elongation to occur. The movement is more or less flat with the earth, and the Snake never coils upwards, as is often figured in old and some new paintings and engravings. It can erect its head and much of its neck and fore part of the body, and this is also done when the creature is in horizontal coils, and quiescent. On moving up a stone or tree the head, neck, and much of the body may be placed against the more or less vertical object, and a small portion only of the body may be left on the ground, but in this position the Snake is liable to fall sideways. On moving up a tree they do not coil themselves round and round it like a rope, but they may do this when still. It is wonderful how Snakes move along and between boughs, and, taking a turn round one with their tail end, swing and look for food, and also how they will make themselves up into a bunch on a fork of a tree, and remain there without falling. They swim in an undulating manner, but the body is wriggled on the same plane as the surface of the water, and not at right angles to it, but in rushing at their prey, both in the water and on land, there is more or less upward or downward bending of part of the body, and a rapid thrust of the head forwards.

On looking at a skeleton of a Snake, the eye is impressed with the great number of vertebræ and ribs. In some great Pythons more than 400 vertebræ have been counted, and each one is movable on its neighbours. There is little distinction to be made by their structures between the vertebræ of the neck, body, and tail, and there is no sacrum. The first vertebra, or atlas, and the second, which has the odontoid process, resemble those of the Lizards, and the first of these is the only vertebra in front of the tail which has no rib. The body of a vertebra has the joint surfaces before and behind nearly hemispherical, and there is a concavity in front to receive the corresponding ball on the back of the vertebra. Above, the spinous processes under the skin of the back are generally long and flat, and project backwards somewhat, and at the base of each, on each side of the canal for the spinal cord, is a process which fits into a cavity in the next vertebra, after the fashion of the Iguana's vertebra (p. 280). Besides these, there are the ordinary articulating processes of the sides. There are twelve jointing surfaces to each vertebra, and great movement is allowed by the ball-and-socket joint, but dislocation is prevented by the "double tenon" and "double mortice," which parts are called zygantrum and zygosphene, as in the Iguana. The transverse processes are very short, and are recognised by a tubercle which offers two facets for articulation with the ribs. But in the tail they are long and inclined downwards. The ribs are, of course, great in number, and each pair is jointed on to the tubercle above mentioned by a ball-and-socket joint, so that an unusual amount of motion, and especially of fore and aft motion, is allowed. There is no sternum, but each rib terminates by a single tapering cartilage, which is attached by muscular connection with the broad scale on the Snake's

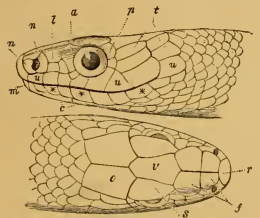
belly. It is by the action of the muscles on the ribs and scales that the Snake may be said to walk on the ends of its very movable ribs. There are no traces of a shoulder girdle or of fore limbs in Ophidia; but the Blind Snakes, Rock Snakes, Boas, and Rollers have rudiments of a pelvis, and the



SKELETON OF SNAKE.
(*a*) Anterior, (*b*) Posterior, view of Dorsal Vertebra.

last have crooked bones terminated by claws externally. The nature of the skull will be considered in treating of the great groups.

The beautiful scales on the body, and the regular plates and small scales on the heads of Serpents, are various in shape, number, ornamentation, and colouring, and they may or may not be keeled, and they overlap. All are thickened skin, and are covered with a delicate scarf skin. The plates on the head are on the same principle as those of Lizards, but there are some others which are peculiar.



SCALES ON HEAD OF SNAKE (*Styas korros*).
(*After Günther.*)
(*n*) Rostral; (*l*) Posterior and Anterior Frontal; (*v*) Vertical; (*a*) Supercilliary; (*o*) Occipital; (*n n*) Nasals; (*l*) Loreal; (*a*) Anterior Ocular or Orbital (Anteocular or Praeorbital); (*p*) Posterior Ocular or Orbital (Postocular or Postorbital); (*u*) Upper Labials; (*t*) Temporals; (*m*) Median Lower Labial or Mental; (* *) Lower Labials; (*c*) Chin shields.

The number of rows of scales on the top and sides of the body and tail differs with the genus and species. Usually there is a double row of scales on the under surface of the tail, and the rest of the under surface of the body has a continuous row of single broad scales, which are very striking in appearance, in contradistinction to the others.

At the moulting period the Snake is dull, lethargic, and careless, and the outer scarf skin comes away as a perfect scarf of the body and eyes.

SUB-ORDER THANATOPHIDIA.* — THE POISONOUS COLUBRINE SNAKES.

The venom of a Snake is secreted by a gland on each side of the front part of the skull, which is close to the maxillary bones that support the long and more or less curved poison fangs. The duct of each gland leads either to a groove in the front part of the fang, or to a canal in the tooth formed by the union of the sides of a groove, and in both instances the liquid poison enters the victim with the tooth, and some is left behind. Those Snakes which have the first fangs of the upper jaw grooved along their front do not differ very much in their shape from the common innocuous Snakes, although some have the power of expanding their neck into a kind of hood; but those which have the hollow teeth are usually distinguishable by their large triangular head, short body, and very short tail, and are viperiform. Thus two great divisions of the poisonous Snakes exist; the first with grooved teeth—the

* θάνατος, death; ὄφις, a serpent.

Proteroglyphia, and the second with canaliculated teeth—the *Solenoglyphia*. The Snakes of the first division or sub-order resemble the common Snakes in their general configuration, and are termed the Poisonous Colubrine Snakes. The second sub-order is often called the Viperine.

The first sub-order is subdivided into two families; in one the Snakes are terrestrial, the *Elapidæ*,* and in the other they are aquatic, the *Hydrophidæ*.

SUB-ORDER PROTEROGLYPHIA.—FAMILY ELAPIDÆ.—THE POISONOUS TERRESTRIAL COLUBRINE SNAKES.

Several genera of Snakes belong to this family, and all have more or less brilliant colours ornamented with lighter colours or red bands, and they may be passed by as innocuous Snakes if they happen to be at rest, and the nature of the jaws and head be not examined. The head is covered with elegant plates, but the loreal is constantly absent, and the muzzle is short, as a rule.† There are large, immovable, grooved teeth placed in front of the maxillary bones, and usually some curved, ungrooved teeth follow; the palate and pterygoid bones, and the mandible, have also curved teeth. A poison gland is developed in relation with the grooved tooth on each side. They are found in all the hot parts of the world except Europe.

GENUS NAJA.—THE COBRAS.

These Elapidæ have the power of stretching out some of the anterior ribs and the skin of the neck so as to produce a long hood when irritated. The head is rather quadrangular, and there are one or two small teeth behind the venomous ones. These Snakes can raise the head and much of the body in the erect posture. Among the varieties of the Cobra are those with spectacles on the hood, or "Gokurrahs," and those with one ocellus or other mark on the hood, named "Keautiahs."

There is only one species, writes Fayrer, of this genus in India, which is called the Cobra-di-Capello, or Naja, and more properly *Naja tripudians*. There is also one species in Western Africa, which is closely allied to the Indian kind, and is called Naja Haje. There are several varieties of the Indian species, each having a distinct name given to it by the natives. They are all most deadly. They all have the hood, and they never attack without distending it. They raise the anterior third of the body from the ground, slide slowly along on the posterior two-thirds, and with the hood dilated remain on the alert, darting the head forward to the attack when anything hostile approaches. This attitude is very striking, and few objects are more calculated to inspire awe than a large Cobra, when, with its hood erect, hissing loudly, and eyes glaring, he prepares to strike. Nevertheless, they are not, writes Sir Joseph Fayrer, aggressive; and unless interfered with or irritated, they crawl along the ground with neck undilated, looking not unlike the innocent Snakes, but the moment they are disturbed they assume the menacing attitude.

The *Naja tripudians*, or Cobra, grows to the length of five feet and a half, or even more. One which was given to Sir Joseph Fayrer by Dr. W. B. Beatson was of the variety called "Kurrees Gokurrah," of a light chocolate colour, without any mark on the hood. It was five feet eight inches long, including the tail, which measured eleven inches and a quarter. In girth it was six inches and a quarter. This is the largest Cobra seen by Sir Joseph Fayrer, but he believes they attain even a greater size than this. The Cobra is found all over Hindostan up to 8,000 feet high in the Himalaya; but Mr. Hodgson says he has never seen it in the Nepal Valley. It is equally dreaded and fatal everywhere. The varieties are numerous, and they are distinguished by the markings on the hood, and by various shades of colour, from the darkest olive or black with a purple iridescence, to a pale chocolate, fawn, or yellow colour. The natives say that the Spectacled Cobra is a Snake of the city or town, and that the Keautiah, or Nág Sárap, prefers the fields and jungle. But both are common about Calcutta. The Cobra is a nocturnal Snake, that is, it is most active in the night, but it is often seen moving about in the day. It is oviparous, and the eggs, from eighteen to twenty-five in number, are oblate, and about the size of those of a pigeon; the shell is white, but tough and leathery. The Cobras feed on small animals, birds' eggs, frogs, fish, or insects.

* *Elaps*, a kind of Serpent.

† The large scales or plates on the heads of most Snakes are beautifully arranged, and are used in the classification. They are named rostral, anterior frontal, posterior frontal, vertical, superciliary, occipital, nasals, loreal, anterior ocular, posterior ocular, upper labials, temporals, mental, lower labials, and chin shields (see diagram on previous page).

COBRA-DI-CAPELLO.

(*From the Living Specimen in the Zoological Gardens, London.*)

They rob hen-roosts and swallow the eggs whole. They prefer taking their food at dusk or in the night. They are said to drink a great deal of water; but it is certain they will live weeks, even months, in captivity without touching food or water. They go into water readily, and swim well, but are essentially terrestrial Snakes. They can climb and occasionally ascend trees in search of food; nevertheless, they have been found swimming. Usually they are found in the roofs of huts, holes in walls, fowl-houses, old ruins, under logs of wood, in cellars, old brick-kilns, and old masonry of stone, brickwork, or mud. Such are the common dwelling-places of these reptiles, where they are frequently disturbed by men, who, stepping on or inadvertently disturbing and touching them, receive their death-wound. The Cobra is most deadly, and its poison, when thoroughly inoculated by a fresh and vigorous Snake, is quickly fatal. Paralysis of the nerve centres takes place, and death occurs with great rapidity, sometimes in a few minutes, especially where the fangs, having penetrated a vein, inoculate the poison immediately into the venous circulation. The number of deaths caused yearly in India by these Snakes is perfectly appalling. The cases in which recovery occurs are very few. Treatment appears to be of little avail unless it is almost immediate; and then in the case of a genuine bite there is but little hope of saving life.

With regard to the natives, the muntra, or spell, is far more potent in their ideas than any drug, and to such they trust when generally bitten. How frequently these fail, the records of any civil station in India will prove; and it is to be feared that the more material remedies of the physician are scarcely more potent for good.

The Cobras are the favourites of the snake-catchers, and it is astonishing with what ease and freedom they are seized and handled by these men even when in possession of their fangs. The snake-catchers render them temporarily harmless by cutting out the poison fangs, but these are quickly reproduced unless, as most generally happens, with the fang all the reserve fangs and germs are removed, in which case the Snake is harmless for life. The Cobra has the power of raising its head, neck, and much of its body for awhile, so that it stands, as it were, on the tail. It moves to and fro from side to side in a very graceful manner. Their elegant movements in the erect attitude which they assume with the hood distended, as they follow the movements of the snake-charmer's hands, make them an object of wonder as well as fear to all, and the superstitions of the natives about them are endless.

Fayrer remarks that the Cobra is an object of superstitious veneration and awe to the Hindoos, in whose mythological histories it takes a prominent place. "In a religion that deprecates the wrath of a cruel and destructive power, by worshipping and propitiating the Deity in whom that power is vested, it is natural that the type of destruction and the incarnation of evil, as represented in this reptile, should be regarded with peculiar deference."

Besides being found on the mainland the Cobra is an inhabitant of the Philippine Islands.

The Egyptian Cobra, or Naja,* is the Aspic of the ancients. Its figure is sculptured on the portals of many ancient temples, as an emblem of the protecting goddess of the world and faithful guardian of their fields. It was, in the time of the great expedition to Egypt under Napoleon, very common in ditches and fields.

Snake-charmers, the successors and perhaps descendents of the "psylles antiques," so celebrated in the writings of Pliny, and rich in the tradition of an art already old before Africa became Christian, say they can change a Naja into a stick, and make it counterfeit death. When they desire to produce this result they spit down the Snake's throat, make it shut its mouth, lay it down on the ground, and give it the order, placing the hand at the same time on the head. The Serpent becomes stiff meanwhile, and falls into a kind of catalepsy. They awaken them by rubbing the tail between the hands.

The Cobras of South Africa belong to the species Naja Haje, and are the "Geel Copell" of the Dutch colonists. They are from three to six feet in length, and are entirely yellow or purplish-brown, both colours sometimes existing in some individuals.

THE RING HALS SNAKE.†

This poisonous Snake is often seen in menageries and in zoological gardens, and is remarkable for its glossy dark tints, fine dark brown eye, and for the dull blackish colour of the head

* *Naja haje.* † *Naja haemachates=Scpedon haemachates.*

and body before the skin-shedding takes place. It has rather a robust body, and the head is scarcely broader than the neck. It is flat above, and the upper lips protrude beyond the edge of the upper surface of the head; hence the eyes appear rather small, giving a malignant and savage expression (Smith). The neck has a quantity of loose skin which forms a fold on each side, and this is extended Cobra-fashion when the creature is enraged, and it is a kind of hood. Probably the extreme length of the Snake is nearly three feet. The range of the Ring Hals Slang is considerable, and specimens have been found everywhere in South Africa. It is very vigilant, and its resting-place can very rarely be approached before it is all activity, either commencing to fly, preparing to maintain its ground, or make an attack. Its holes are in and about mouse, rat, and mole burrows, and although it retreats, it is a valiant and very poisonous Snake. The natives properly consider it the most courageous of all their Snakes, and one of the most poisonous. When in confinement and irritated it evinces great ferocity, opens its mouth so as to be in readiness to seize any object, and the poisonous secretion comes out in drops from the fangs, which are raised and ready to strike.

GENUS OPHIOPHAGUS.—THE HAMADRYAD SNAKE.*

A snake-eating Snake, with a beautifully shielded head and a neck dilatable like a Cobra's is, of course, interesting, and especially when it is known that it grows to the length of fourteen feet, and is bold and disposed to attack, instead of retreating, like the Naja.

The body is largely scaled, and the head is short, depressed, and scarcely distinguishable from the neck, which is dilatable. The body scales are smooth, minute, imbricate, and in transverse rows. The plates on the head are very distinct, and the occipitals are surrounded by three pairs of large shields, the two anterior being temporals. The ventral scales are entire, and there are more than two hundred of them, and the posterior sub-caudals are two-rowed. The tail is slender, and becomes very small at the tip. The maxillary bone has a large fang in front, which is perforated at the end, showing a longitudinal groove in front. A second small, simple tooth exists at some distance behind the fang. It is called "Sunkerchor" by the natives, and has a general resemblance to the Naja in shape. The colour varies acording to age and locality. The young Ophiophagus may be mistaken for a Snake of another genus, such as *Dipsas dendrophila*, an innocent Snake.

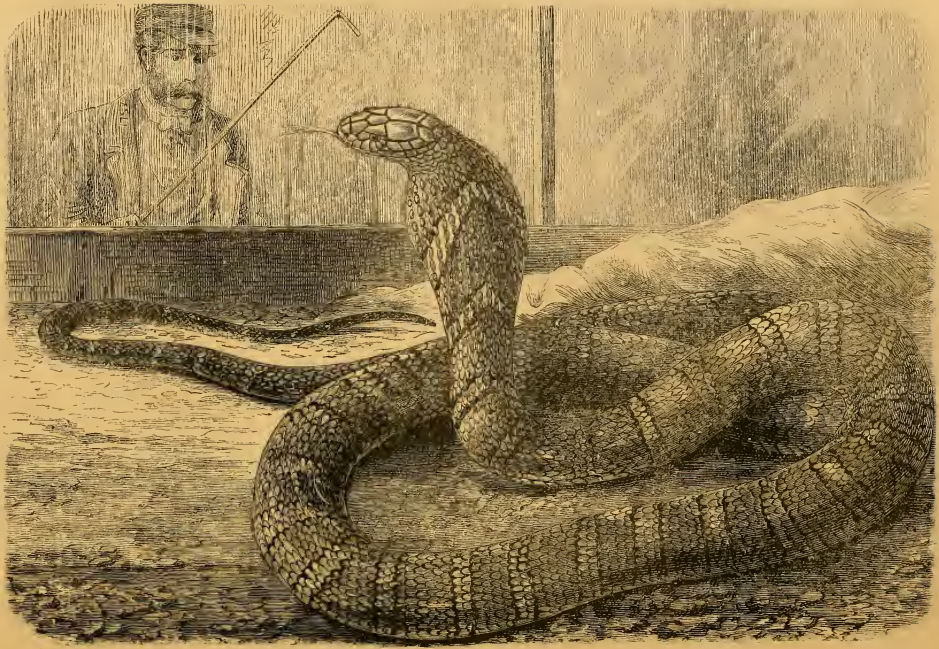
The Ophiophagus is probably the largest and most deadly of the Indian Snakes; and, fortunately, though widely distributed, it is not very common. According to Günther, it is found in almost every part of the Indian continent, and in the Andaman and Philippine Islands, in Java, Sumatra, Borneo, and, according to Duméril, in New Guinea. It reaches from twelve to fourteen feet in extreme length, and is common near Cuttack, and there is a dusky variety from Rangoon. It does not appear to be much if at all known in the North-west or in Central India; it is most common in the damp climates of Assam, Bengal, Orissa, and Southern India. It has been caught in the Botanical Gardens, near Calcutta, and it is said by the snake-catchers to be not uncommon in the Sunderbunds, and it takes to water.

The dilatable neck is not altogether peculiar to the Snakes just mentioned, and Fayrer observed that in *Compsosoma radiatum*, an innocent Snake, the neck and much of the whole body dilate vertically when it is excited and about to strike, presenting a very remarkable appearance; but the power of dilating the neck is better marked in the *Najidæ* than in any other Snake. Another equally innocuous Snake, called *Tropidonotus macrophthalmus*, found in the Himalayas, has the power of dilating the neck, and it greatly resembles the Cobra.

An Ophiophagus in the Zoological Gardens of London knew its keeper and feeding-time. When a Snake was put into its cage it was immediately on the alert, and the victim tried to escape. But the attack was begun at once, and the prey was seized behind the head and dragged on to the floor, and gradually swallowed head first.

Besides the Ophiophagus, there is another snake-eating venomous Serpent in India, which lives principally on others belonging to the innocuous Calamaria family. This is a ground Snake, slow in its movements, and it prefers hilly to level country. Singularly enough, it greatly resembles its prey in outward appearance, and belongs to the genus *Callophis*.

* *Ophiophagus elaps.*



HAMADRYAD SNAKE.

GENUS BUNGARUS.—THE BUNGARUMS AND KRAITS.

Two kinds of very venomous Snakes, which often reach four feet in length, and which have not the power of enlarging the neck, are found nearly all over India. One can be recognised at once by its ornamentation, which is that of a number of rings alternately steel-blue and bright gamboge-yellow; by its triangular outline, for there is a ridge on the top over the vertebræ, where there is a line of hexagonal scales; and by its hard, blunt, bony end to its tail. It is called the Bungarum Pamah.* It is common in Bengal and in Southern India as well as in Burmah, and its bite is very dangerous. It does not erect its head, but lies coiled up in curves, and, when disturbed, jerks itself out like

BUNGARUS FASCIATUS.

a spring, but without extending its whole length of body. This Snake is not so common as the Cobra, and is rarer than the other kind about to be noticed. No doubt à great fatality accompanies the bite of its small teeth, although the poison is somewhat long in acting.

The other kind is called the Krait, or Gedi Paragoodoo,† and it differs much in colour from the Bungarum. It has the lower part of the body of an uniform white colour, and the upper parts are bluish or brownish-black, uniform or with more or less numerous very narrow white streaks, not quite as broad as a scale, and generally radiating from a white vertebral spot. The tongue is white, and the iris is black. It sometimes insinuates itself into houses, in the verandah, ball-rooms, or the ledges of doors or jhilmils, into bookcases, cupboards, &c., and in such situations is not unfrequently the cause of fatal accidents. Next to the Cobra it is most destructive to life.

Australia has several of these poisonous *Elapidæ*, and some are more venomous than others. Thus, the Grey Diemenia ‡ produces an irritation like that of the sting of a bee, after its bite, but the Brown Snake § is very venomous. The Red Capped Snake,‖ a common little Snake, is venomous, but does

* *Bungarus fasciatus.* † *Bungarus cæruleus.* ‡ *Diemenia psammophis.*
§ *Diemenia superciliosa.* ‖ *Brachysoma diadema.*

CORAL ELAPS (*Elaps corallinus*).

not seem usually inclined to bite, and is insectivorous, eating also frogs; but the Black Snake, the most common Australian venomous Snake,* a lover of water and marshy places, has many of the actions of a Cobra. Equally fatal is the bite of the Brown-banded Snake,† which frequents the plains. The Death Adder,‡ with very variable colorisation, and loving warmth and sandy places, and assuming the form of the letter S on being irritated, is a very fatal enemy. It has a large head, and the tail ends in a short recurved spine.

The *Elapidæ* of the New World are usually beautiful Snakes. The Harlequin Snake (*Elaps pulvius*), a small burrowing kind, and the Coral Elaps, from Rio and the Brazils and Central America, are examples.

FAMILY HYDROPHIDÆ.—THE POISONOUS SEA SNAKES.

The members of this family, all of which lead an aquatic life, may be recognised at once by their shape, and some peculiarities which relate to their method of life. The body is comparatively flat at the sides, and the tail is decidedly so, and acts as a propeller and steerer, and the nostrils open upwards and are closed with a valve, the tongue being short. They are all venomous, and inhabit the sea, near land, salt-water estuaries, and tidal streams. They have a very wide range of distribution, being found on the coasts of India, in the Indian and Pacific Oceans, from Madagascar to the Isthmus of Panama, in the Eastern Archipelago, and in the seas between Southern China and North Australia. Some of them attain a considerable size. Günther speaks of some species attaining to the length of twelve feet. The longest seen by Sir J. Fayrer was under five feet, there is no reason to believe that they attain to so great a size as certain fabulous stories would suggest.

They swim like fish, and live, with some exceptions, continually in the sea or tidal water. When thrown on the land by the surf, as they constantly are at Pooree and other places along

* *Pseudechis porphyriacia.* † *Hoplocephalus curtus.* ‡ *Acanthophis antarcticus.*

the coast, they are helpless and almost blind. Their food consists of fish and other aquatic animals, which they pursue and overtake in the salt water. There are certain parts of the Bay of Bengal in which they are often seen in great numbers, and their movements in the clear blue water are very agile, graceful, and beautiful.

The *Hydrophidæ* generally have no well-marked ventral plates, and the abdominal scales differ little from those of the rest of the body, which are generally hexagonal, laid side by side, occasionally slightly imbricate, and in some tubercular, a small tubercle being found in the centre of each scale. But one genus (*Platurus*) has abdominal scales like the Land Snakes, and is sometimes found in marshy ground near the sea.

The nostrils and head shields of the Sea Snakes are peculiar. The eyes are small, with circular pupils, which contract so much when the Snake is taken out of water that it is said to be almost blind.

They are very poisonous. The case related of a sailor of H.M.S. *Algerine*, who was bitten by one caught at Madras, proves them to be so. Fayrer instances a fisherman who was bitten by a Salt-water Snake somewhere near the Salt Lakes, and who died in one hour and a quarter. The fishermen on the coast know their dangerous properties, and carefully avoid them.

The genera *Hydrophis, Pelamis, Platurus*, and *Enhydrina* belong to this family.

SUB-ORDER SOLENOGLYPHIA—THE VIPERINE SNAKES.

These poisonous Snakes have the head triangular in shape and enlarged behind, whilst the tail is short in relation to the body. They have a small upper maxillary bone on each side, which has one large, hollow, perforated, erectile fang, and often some others growing to replace it. There are small curved teeth on the lower jaw and palate. Most of these Serpents are viviparous, and they may be divided into two families. The Vipers (the *Viperidæ*) constitute one, and they have a large, broad head, a vertical and long pupil in the eye, and the top of the head is covered with very little plates and scales. The tail is short, and usually there are two rows of plates beneath it. They have the region between the eye and the nostril flat. They are viviparous, and inhabit the Old World and Australia, Africa producing the greatest number of them. Their poison gland communicates with the canal in the tooth, and the venom is usually very destructive. This they appear to know, for having bitten their prey, they leave it, knowing that it will die, and then they prepare to swallow it.

GENUS PELIAS.*—THE ADDER, OR COMMON VIPER.

This is the sole British representative of the family, and is the only poisonous reptile indigenous to the country. It is far more numerous in Scotland than the Common Snake, and it is found now and then, and formerly in abundance, in all parts of England and Wales. Open woodlands, brushwood, dry heaths, and sandy wastes, are its favourite places, and it does not seek, or necessarily live near, water. Found solitary now and then, or with their young, they are discovered intertwined with several of their own species, when hibernating in their retreats. They are not confined, however, to England and Scotland, for they are found in France, Spain, and from Southern Italy to far north in Russia. Ireland has not this poisonous Snake. They are very variable in their colour; some are nearly olive, and others are a rich deep brown or dirty brownish-yellow in their general ground colour. There is a mark between the eyes, and a spot on each side of the hinder part of the head, and a zigzag line running the whole length of the body and tail formed by a series of confluent rhombs, as well as by a row of small triangular spots on each side, and all these are darker than the ground tints. On looking at the head, it is found to be covered with small scales and some plates more or less regularly placed. The head is almost oval, depressed, and it widens behind the ears. The gape of the mouth is great, and there are no teeth in the upper maxillary bones except the poison fangs. There is a row of small teeth on the palatine bone on each side of the palate. The neck is smaller than the back of the head, and the body increases to nearly the middle. It slightly diminishes to the vent, becoming then abruptly smaller, and lessening to the extremity of the tail.

This Snake is probably the "Εχις of Aristotle, and the *Vipera* of Virgil's Third Georgic, and the

* *Pelias berus.*

VIPERS.

nedre or *eddre*—Adder of the Anglo-Saxons and country people of some parts of England. It avoids man, and when seen basking in the sun will move off on being disturbed; but when injured or brought to bay, it will raise its neck and head and draw back the last a little, and then project it quickly,

ADDER, OR COMMON VIPER.

opening the mouth and snapping at the offender. Dogs get bitten by treading on Vipers, or disturbing them, and there are occasional instances of men being bitten. The bites are rarely fatal, but produce much constitutional and local disturbance in unhealthy people, especially in hot weather. Some naturalists suppose that the Viper does not kill its usual prey—mice, small rats, and birds—with its

venom, and only entwines and swallows them, but if the Viper stops a mouse with its teeth, the venom will enter the wound. Formerly Vipers were in demand, for Viper-broth was a remedy, or the Snake might be boiled like a fish, or given as a powder to those patients who suffered from ulcers, or a corrupt state of the system. They were caught in numbers with a cleft or forked stick which the Viper-catchers drove down immediately behind the head. They then seized the creature by the tail, and put it in a bag. Like many other Snakes, Vipers live long without food, and they do not feed well in captivity. They are, of course, viviparous, and the young, sometimes ten or fifteen in number, may be seen with the parent, looking like so many worms with large heads. The eggs are hatched within the Viper,

CERASTES VIPER.

and hence it has happened that eggs have been laid and young Vipers hatched from them. Whether the young take refuge in the mouth of the old one, and crawl into her throat in times of danger, or whether they get under her body and glide away, are questions which have provoked much discussion. The young Vipers certainly could get into their parent's mouth, but whether they could get out again is another thing, and therefore it is best to disbelieve this remarkable parental trait in the Viper, of protecting her young in her mouth.

The ancients had a notion that the young Vipers killed their mother in coming into the world, and hence one or more of these parricidal reptiles were placed in a bag with a human parricide and drowned as the punishment of this greatest of crimes.

Another example of the Viper group belongs to those which are more or less "horned." It lives in Hungary, Dalmatia, and Egypt, and has a small, soft horn covered with scales on the muzzle.* The Horned Sand Snake of Egypt, or the Cerastes Viper, which is of a greyish tint, and hides

* *Vipera ammodytes.*

itself in the sand, has a horn above each eye. It is to be seen figured on ancient monuments there.* Dr. Andrew Smith states that there are six kinds of Vipers in South Africa, and that they are mostly indolent, and are heedless of the approach of man. One of them, *Vipera (cerastes) caudalis*, has a slender, recurved head-spine of about a line or a line and a quarter in length, and the tail appears dwindled, so short and tapering is it. It is especially dangerous, for it will not move off but submits to be trodden on accidentally, and then bites. When once it seizes the obnoxious object, it holds on with great tenacity, and does not rush off when removed. The Horned Viper,† the Hornsman of the Cape colonists, has the eyebrows armed with a clump of lengthened spinous scales

PUFF ADDER.

forming a short horn. It has large curved fangs, and swollen upper lips. The Berg Adder ‡ of the Dutch colonists and the Puff Adder § of the Cape colonists are well-known African kinds, and are generally found on the sides of hills or on dry sandy ground. The River Jack Viper ‖ of the west of Africa is a formidable-looking Snake with a flat head, a longish horn on each side of the snout, a small neck, short body, and thin tail. It puffs itself out when visitors look at it in captivity, and sends forth the inevitable hiss.

The kinds of East Indian Vipers are arranged in two genera—one in which the Snakes have a very large nostril (genus Daboia), and the other in which the nostrils are small (genus Echis). Sir Joseph Fayrer states that "The Daboia, or Russell's Viper, is called by the natives about Calcutta 'Uloo Bora,' from the uloc grass in which it is often found. In Bengal it is called 'Jessur,' 'Siah'-chunder Amaiter.' It is common in Bengal, and is frequently caught in the Botanic Gardens near Calcutta, also in the South of India, Ceylon, and Burmah.

* *Vipera cerastes.* † *Vipera cornuta.* ‡ *Vipera atropos.* § *Vipera arietans.* ‖ *Vipera rhinoceros.*

"The Daboia is nocturnal in its habits; in confinement it is sluggish, and does not readily strike unless roused and irritated, when it bites with great force and determination. When disturbed it hisses fiercely, and when it strikes, does so with great vigour. Its long, movable fangs are very prominent objects, and with them it is capable of inflicting a very deep as well as poisoned wound. The markings on its body are very beautiful. It lives on small animals, such as rats, mice, and frogs. My snake-man says it will go into water. It is however, terrestrial in its habits. Its loud hissing when disturbed is calculated to warn those who come within its dangerous proximity. It is apparently a hardy reptile, and I had one about forty-four inches in length, which lived a whole year without food or water."

The genus Echis contains only one Indian species, *Echis carinata*. The native name is "Afaë" in Delhi. It is unknown to the natives in the neighbourhood of Calcutta.

The Echis is very fierce and aggressive, writes Fayrer; it is always on the defensive and ready to attack. It throws itself into a double coil, the folds of which are in perpetual motion, and as they rub against each other they make a loud rustling sound very like hissing. This sound is produced by the rubbing together of three or four outer rolls of carinated scales, which are very prominent, and point downwards at a different angle to the rest. This little Viper can dart a foot or more at its prey, but it does not hiss at all. Its fangs are very long and mobile, like those of the Daboia, and its eye has a peculiarly vicious appearance. This active Viper is less than two feet in length.

SUB-FAMILY CROTALIDÆ.—THE RATTLESNAKES, OR PIT VIPERS.

The second group of the Vipers are called "Pit Vipers," and the term is derived from the presence of a little depression on both sides of the face between the eye and the nostril. This is a peculiarity of several genera, some, but not all, of which have species furnished with complete or incomplete "rattles." Most of the Pit Vipers have large heads, which may be completely or not at all covered with large plates. They have the pupil of the eye vertical, and elliptical in shape.

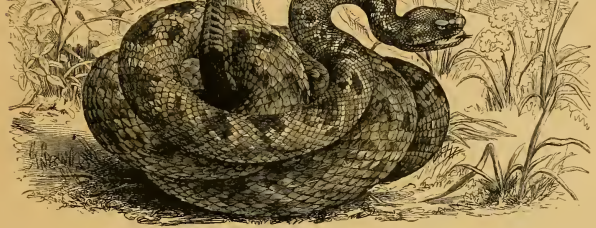
Amongst these very venomous Snakes, all of which have a canal in the poison fangs, the Rattlesnakes are the most interesting. They are readily known by the end of the tail being made up of a number of horny, round, and flat pieces capable of making a sharp sound, not unlike that of a large Grasshopper, by their friction during the vibration of the tail. The head, large behind, is covered there with small ordinary scales, and plates are noticed only in front. They constitute the genus Crotalus, and there are several species more or less remarkable for their geographical distribution. The genus is essentially American.

The American herpetologist, Holbrook, thus notices the Common Rattlesnake (*Crotalus durissus*):—The very large head is flattened above, triangular, rounded in front, covered with plates only in front, and with scales on the vertex and back of the head. There is a deep pit between the nostril and eye. The body is long and robust, and is ash colour above, with irregular cross-bars confluent near the tail. The vertebral line is yellow, and the flanks are tinged with the same colour. The tail is short and thick, and furnished with rattles. The nostrils are large and near the snout, but open laterally. The eyes are large and brilliant, and the pupil is dark, oval, and vertical, and the iris is flame-coloured. The neck is much contracted, and its scales are keeled. An average specimen is four feet long and six inches in girth, and the length of the nine rattles is about two inches.

It lives on rabbits, squirrels, rats, &c., and is usually a slow, sluggish, reptile, never wantonly attacking or destroying animals except as food, or unless disturbed by them. A slight touch, however, will effect this, or even the rustling of leaves in the neighbourhood. On these occasions, it coils itself, shaking the rattles violently as a sign of rage, and strikes at whatever is placed within reach. In its native woods one may pass within a few feet of it unmolested. Though aware of the passenger's presence, it either lies quiet or glides away. It never follows, but will slowly retreat, but it is prepared to strike if necessary. It is remarkable that the Rattlesnakes never strike unless coiled, and that if once thrown from that position they can be approached without danger. Years ago they were common enough, but the Hog—which is their great enemy—and man—with his enclosing and tilling of land—have thinned their numbers considerably.

Formerly, and to a certain extent now, this Snake had the widest range of all the American

Crotalidæ, being found in nearly all parts of the United States, from lat. 40 on the Mississippi to the Gulf of Mexico. They are now more and more restricted to the south-east. The cuticle on the ends of the tail is arranged in a series of rings, loosely connected together, so as to constitute the rattle. There are many of these rings, according to the species and age of the Snake; but Rattlesnakes grow more than one ring in the year, and therefore the size of this appendage cannot be used in estimating their age. They lose rings and others come, and the greatest known number is probably twenty-one. They are very curious and similar, and the piece immediately connected with the body seems to be moulded on the last vertebra of the tail, from which it is separated by a layer of the true skin by which it is secreted. Its surface presents three circular elevations corresponding to three protuberances. Of these, the first, or that nearest to the body of the reptile, is the largest, and the other two rings are encased in the succeeding piece, which is connected in a



COMMON RATTLESNAKE.

similar manner to the next ring, and so on throughout the series. The posterior two-thirds of each ring are thus embraced by the next, so that of the three prominent rings that project from each piece the anterior only is visible, the two posterior being contained in the next ring, with the exception of the ultimate one. Each piece is loose, and plays freely about that which it envelops. There is no muscle, and the noise is produced by a shake of the tail.

Bates testifies to the slowness of the attack of other species of Rattlesnakes. When on the Lower Amazons he saw a Rattlesnake for the first time. He heard a pattering noise close to him, and thought some creepers on a tree were about to fall; but when the wind lulled, it was evident that the noise came from the ground. On turning his head to look, a sudden plunge startled him, and a heavy gliding motion betrayed a large Serpent making off from beneath his feet. This was a Rattlesnake. Again, his little dog Diamante rushed one day into a thicket and made a dead set at a large Snake, whose head he saw above the herbage. The foolish little brute approached quite close, and then the Serpent reared its tail slightly in a horizontal position and shook the terrible rattles. It was many minutes before Bates could get the dog away.

The Water-rattle* is seen in damp and shady places, and abounds in East Florida, the Gulf States, and Mexico, and reaches eight feet in length, and its dusky colour, bloated body, and grey and yellow iris, give it an expression of sullen ferocity. It is also called the Diamond Rattlesnake.

Central America and Brazil have the "Horrid Rattlesnake,"† which is a most widely dispersed species of Eastern North America. It has a black band across the forehead, and another

* *Crotalus adamanteus*, or *rhombifer*. † *Crotalus horridus*.

from the eye to the angle of the mouth. There are two large black bands which begin behind the head and run along the neck and back for some distance. The nasal plates are very small, and the space between the orbits is covered with plates or scales, larger than those in the others.

The Missouri Rattlesnake * is slim, and is from two to three feet long. They inhabit the country bordering on the Rocky Mountains, and from the Mexican to the British boundaries. It is found from California to Utah, but the Yellowstone is its favourite locality. *Crotalus lucifer* is found in Arizona and in the Pacific region.

The Prairie Rattlesnake, or Massasauga,† is distributed in the Prairie countries from Ohio and Michigan westward, and it does not appear to go farther westward than the Yellowstone. They

HORRID RATTLESNAKE.

prefer an unproductive soil, where their sluggish gait may not meet the opposing obstacles of grass and mud; and for their hiding-places they seek the holes of the Prairie-Dog (*Cynomys ludoviciana*). It has some large plates on the head, and the rattle is much smaller than in the other Rattlesnakes, and is included in the genus Crotalophorus (Gray). There is also a small species in the south,‡ which hides in grass and feeds on field mice.

Coues, the American naturalist, thus writes about the rattle:—"The purpose subserved in the economy of the animal by this singular organ has been the subject of much speculation and discussion. It is difficult to perceive what use the rattle can be, either in procuring prey or avoiding enemies. We do not know that it comes into play at all in the pursuit of prey, while the actual result of its use as a menace in self-defence is the reverse of beneficial to the Serpent, since the sound serves to direct and provoke attack from all enemies which the animal has occasion to fear."

"The principal enemies of the Rattlesnake besides man are hogs, peccaries, and deer. The former

* *Crotalus confluentus* (Say)=*C. lecontei*. † *Crotalophorus tergeminus* (Say). ‡ *Crotalophorus miliarius*.

kill the Serpent when coiled, by striking with the hoofs and teeth, and in some regions derive no small part of their subsistence from this source. The popular belief that the venom of the Rattlesnake is innocuous to hogs is merely a partial statement of the fact that the fluid usually fails to enter the circulation through the layer of adipose tissue with which these animals are commonly covered. The venom is conceded to be innocuous when introduced to the stomach, and the flesh of the Rattlesnake is as edible as that of other Serpents. The fatality of the Rattlesnake's bite is by no means the constant element generally supposed, but the result may vary from the slightest amount of poisoning to one rapidly fatal."

"There seems to be a special and peculiar enmity existing between the Rattlesnake and Moccasin Snake, and the Black Snake (*Bascanium constrictor*) and the 'King Snake' (*Ophibolus getulus*, Say); these last two species waging a constant warfare against the former, and invariably conquering, according to information received from reliable parties. After the conflict, the vanquished is eaten by the victor. In one case reported, a large Black Snake had seized a Rattlesnake and entwined two or more folds behind his head, and several six or eight inches farther back; then by muscular effort had torn the body. It is a well-known fact that both Rattlesnakes and Moccasins will endeavour to get away from the 'King Snake,' and in the South this beautiful and harmless species is protected in view of this fact."

In Surinam, Guiana, and the Brazils there is a fine Snake called the Bushmaster,* which grows to more than six feet in length, and it is interesting from having many of the habits of the true Rattlesnakes, and a rudiment of a rattle. The structures at the end of the tail consist of ten or twelve rows of spiral scales which are slightly recurved or hooked at their summits. It does not climb trees, but frequents underwood near the rivers, and is well known for its venomous powers. The natives call it "Surukuku."

Some of the Pit Vipers have a large plate on the top of the head instead of the small scales of the genus Crotalus, and are included in the genus Trigonocephalus, and Charles Darwin notices one in his usual inimitable manner, at Bahia Blanca:—

"Of reptiles there are many kinds; one Snake (a Trigonocephalus, or more properly a Cophias), from the size of the poison channel in its fangs, must be very deadly. Cuvier, in opposition to some other naturalists, makes this a sub-genus of the Rattlesnake, and intermediate between it and the Viper. In confirmation of this opinion, I observed a fact, which appears to me very curious and instructive, as showing how every character, even though it may be in some degree independent of structure, has a tendency to vary by slow degrees. The extremity of the tail of this Snake is terminated by a point, which is very slightly enlarged, and as the animal glided along it constantly vibrated the last inch; and this part striking against the dry grass and brushwood, produced a rattling noise which could be distinctly heard at the distance of six feet. As often as the animal was irritated and surprised, its tail was shaken, and the vibrations were extremely rapid. Even as long as the body retained its irritability a tendency to this habitual movement was evident. This Trigonocephalus has, therefore, in some respects the structure of Vipers, with the habits of a Crotalus; the noise, however, being produced by a simpler device. The expression of the Snake's face was hideous and fierce; the pupil consisted of a vertical slit in a mottled and coppery iris; the jaws were broad at the base, and the nose terminated in a triangular projection. I do not think I ever saw anything more ugly, excepting, perhaps, in some of the Vampire Bats. I imagine this repulsive aspect originates from the features being placed in position, with respect to each other, somewhat proportional to those of the human face, and thus we obtain a scale of beauty."

North Carolina and to the south, and across to the Rocky Mountains, seems to be the country where a fish-eating Snake,† with a large plate on its vertex, and a pointed rattle-less tail, is found. It is usually called the Water Viper. The Copper-head Snake,‡ often wrongly called the Moccasin Snake, belongs to this group also, and preys upon frogs and birds, and probably fishes. It has a bad character amongst the inhabitants of the United States south of the forty-fifth parallel of latitude.

The last group of the American Pit Vipers is that of the Lance Snakes. One of these is the Yellow Viper, of Martinique,§ called Fer-de Lance there, and the Rat-tailed Serpent, at St.

* *Lachesis mutus.*
† *Cenchris piscivorus.*
‡ *Trigonocephalus (Ancistrodon) contortrix.*
§ *Bothrops lanceolatus.*

Lucia, in the West Indies. Other and very venomous Serpents of the group live on the mainland, and the principal are Jararaca* and *Bothrops atrox*.

Halys is the only East Indian genus of Pit Vipers or Crotalidæ with a vestige of the rattle, and it is reduced to a simple horny spine at the end of the tail. Many of these Indian *Crotalidæ*, such as the Trimeresurids, are arboreal Snakes, and in colour resemble the foliage or branches of the trees in which they live. These *Trimeresuri* are said to be naturally sluggish,

COPPER-HEAD SNAKE (*Ancistrodon contortrix*).

and are apt to lie quietly, hidden by the leaves or branches they resemble in colour, until disturbed; then they are sometimes fierce and aggressive, bite savagely, and make a hissing sound as they prepare to strike, which they do by first drawing back the head and anterior part of the body, and then darting it forward with great rapidity. Their tail is prehensile.

The venomous Snakes kill by inoculating their victim with a liquid poison, which escapes by a groove in front of the fang, or by a canal formed by the cohesion of the edges of the groove. After depriving their prey of the power of escape and resistance, they proceed to swallow it. On the other hand, the non-venomous Snakes stop, and wound, and often kill with their well-developed solid teeth.

* *Craspedocephalus* (*Bothrops*) *brasiliensis*.

and then commence the extraordinary swallowing, having often enveloped their prey in the folds of their body, crushing it more or less.

In the first group a special adaptation of the usual bones of the head enables the contents of the poison-gland—probably an altered and adapted salivary gland—to be injected, and there are remarkable movements permitted, which enable the Snake to bite and to protect its fangs from subsequent injury. Then in the act of swallowing, a peculiar mobility and separability of the jaws and associated bones come into play, and this is, of course, noticed also in the second group. In endeavouring to explain

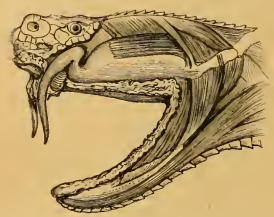
YELLOW VIPER, OR FER DE LANCE.

these necessary actions and movements it must be noticed, first of all, that whilst the bones which enclose the brain of the Snake are solidly united, those of the face, upper and lower jaws, and palate, and those which joint the lower jaw with the skull—the lower jaw with the quadrate, and this with the squamosal—are loose and more or less inter-connected by fibrous tissue, permitting of much separation and movement (see Note, p. 275). The movements and special adaptations are of two kinds, those relating to the striking with the poison fang, and those which refer to the forcing back the prey into the mouth and the expansion of the jaws sideways, in order that a huge morsel should pass into a dilatable throat. The first will be now explained, and the last will be noticed farther on.

The Rattlesnakes have been carefully studied, and they may be taken as the type of the venomous Snakes, so far as the construction of the skull is concerned.

The pre-maxillary bones are very small and toothless. The maxillary bone has not the elongate shape of that of the non-poisonous Snake, but it is short, somewhat bag-like, and hollow, and a long curved fang is on that part of it which resembles the bottom of the bag, and which, in the position of rest, looks backwards along the palate. Hence, when quiet, the fang is hidden in folds of the soft tissues of the roof of the mouth. The hollow of the bone is below the pit in front of the eye. The upper and inner part of the maxilla is jointed with a pulley-like surface on the lachrymal bone, so that the bag-like maxilla and its tooth can move forwards and backwards on the lachrymal bone, the end of the fang describing about a quarter of a circle, and being vertical when at the fullest forward movement—in the striking position. The lachrymal bone has some movement on the frontal bone. Now, the mechanism of the bones of the palate and of the side of the head has to produce a forward and backward movement of the free end of the maxillary bone; and it has especial connection with the necessity of the fang being vertical and ready to strike when the mouth is widely open, and of the curving back of the fang along the palate, out of harm's way, when the mouth is shut.

The fang, and its supporting bone hinged on to the lachrymal bone, can be pushed forward as the mouth opens in the following manner:—There are three bones on each side of the mouth whose names are already very familiar, and they are, a small palate bone armed with curved teeth; a long, flat, bar-like, transverse bone, and the pterygoid bone, which is long and stout, and as usual is united behind with the quadrate bone close to the lower jaw. The transverse bone is attached in front by a hinge-like joint with the maxilla, and behind it is connected with the pterygoid. The palate bone is also attached to the pterygoid by a joint, and is connected by fibrous tissues with the skull. These bones form a long line, and as a whole they are in contact with the quadrate bone behind, and with the upper edge of the hinder part of the tooth-bearing maxilla in front. The quadrate bone and the maxilla being movable on the skull, the motion of the first is conveyed to the latter fang-bearing bone by means of the intermediate rod. Now, when the mouth is shut, the quadrate bone is placed so that it reaches out from the squamosal bone, on the side of the skull, downwards and backwards, and the pterygoid bone with its prolongation, the transverse, is pulled backwards. So that the hinder part of the maxilla is pulled backwards, and the fang rests on the mucous membrane of the palate. When the Snake opens its mouth to strike, the lower jaw separates from the upper, and the quadrate bone is pushed forward at its end at the lower jaw. This movement acts on the line of bones; the pterygoid is pushed forwards, and the transverse also, so that a force acts on the maxilla tending to press it forward, and to make its lower or toothed part move in a corresponding direction on the joint with the lachrymal bone. This peculiar movement is the result of the combined movements of the transverse and palatine bones and their joint or union with the pterygoid.



HEAD OF RATTLESNAKE, SHOWING FANGS, AND MUSCLES OF POISON GLANDS.

The next proceeding is the snap or attempted closure of the jaws on the prey, and the same muscle (or rather part of it) which closes the lower jaw on the upper compresses the poison gland, which lies between it and the side of the skull above and behind the maxilla, and forces a drop of its secretion down its duct which leads into the canal of the tooth. As soon as this is done the mouth is closed, and the long bones pull on the maxilla and restore the fang to its place on the palate.

In the Zoological Gardens in the Regent's Park, London, the Rattlesnakes may be seen exercising, as it were, their jaws, before the Guinea-pig, a favourite prey, is given them. They open the mouth widely, and immediately the long, slightly-curved, slender fangs project well in front, and are at right angles with the upper jaw. It appears as if each slipped out of an envelope of soft skin which never quite leaves their base, or where they are attached to the maxillary bones. Then the mouth is shut and the teeth are retracted during that operation.

It is evident that by its will the Snake can move its maxillæ and fangs, and that when it has killed and begins to swallow by opening its mouth, which is pressed on the victim, the poison teeth are not struck forth. Hence, although opening the mouth is necessary to the protrusion of the fangs, as noticed above, still there are muscular actions required within the sphere of the will. A muscle called the spheno-pterygoid contracts when the rod of bones is desired to be pushed forwards, and the folding back of the maxilla and tooth is produced by the contraction of the ectopterygoid and spheno-palatine muscles.

The fangs are often cast or shed, and they are delicate, tubular, sometimes half an inch in length, sharp at the free end, and on the whole rather scythe-shaped. The microscope shows that the canal is not a simple passage through the midst of a solid tooth, but that the tooth may be considered flat and to consist of dentine within and enamel all round, and to have been bent so as to form a groove, and finally, by union of its edges, a canal. The poison looks like limpid syrup.

The symptoms of poisoning point to exhaustion and paralysis of the nervous centres, and to a rapid failing of every function of the body. Local paralysis of the bitten part, blood spreading in the skin near the wound, faintness, vomiting, bleeding, and mucous, bloody, involuntary motions precede loss of consciousness, and convulsions close the sad scene. The examination after death reveals but little, and Sir Joseph Fayrer states that in animals the blood nearly always coagulates firmly on removal from the body, and there appears to be some doubt about the condition of that fluid in man, which is said to become uncoagulable and altered in its microscopic characters. The poison acts with most vigour on warm-blooded animals, and especially on birds, for a vigorous Snake bite will destroy a fowl in a few moments. Cold-blooded animals succumb less rapidly, and all die if bitten decidedly; but the poisonous Snakes are not affected by their own poison, or of that of their kind. How the poison kills is a matter of doubt. Dr. Holford believes that the molecules of the poison speedily grow into cells, and that these multiply rapidly, and extinguish, by their capacity for absorbing oxygen, the animal heat and powers. But they have not been seen before death by himself or Sir J. Fayrer, and what was seen after death may have been the result of changes in the last hours, and subsequently. In some cases there is not time for this change, and the poison is as rapid in its action as prussic acid, and is an equally incomprehensible agent of destruction. After a while, symptoms of blood poisoning come on, and should the patient last, the death of portions of the body and of the blood is evident. But the primary action is unknown. The poison being very readily and rapidly absorbed into the circulation, the only chance of successfully treating a bite, by any of the venomous Snakes in hot climates, is to stop its passage by the veins to the heart as quickly as possible. A ligature should be applied immediately above the bite, that is, between it and the body, if on a limb. The natives of India apply one or more, not only just above the bite, but up the limb in several places. A garter, brace, piece of cloth, or anything that can be tied round quickly and strongly, will do. It must be tightened to the *utmost*, and a stick should be put in the strap or string, and twisted. The part soon becomes livid from the arrested blood. Then, if no surgeon is near, have a burning piece of wood placed to the wound, or a live coal, or flash gunpowder on it. A red-hot iron, caustic, or carbolic acid will be still better. Amputate if you are wise, and the patient will submit. Should the bite be where a ligature cannot be applied, a knife must be got out, and the flesh mercilessly cut out at once. Suction is dangerous; cupping glasses are rarely at hand. It is not right to pin one's faith on liquor ammoniæ, for it is not an antidote. If the poison has been absorbed the pulse falls, and prostration commences. Then stimulants are the only hope—ether, brandy, ammonia in water, mustard to the pit of the stomach, and quietude. The patient is in danger of sinking from nervous exhaustion, and, therefore, all the barbarous plans of walking about, flogging, &c., are worse than useless. Every country has its antidotes, and every practitioner believes in one or more, but scientific experiment under Fayrer and Brunton has shown that there is no proper antidote. Certainly, in less venomous Snake bites, such as those of the Australian Snakes, Dr. Holford has had success in injecting ammonia into the veins.

The venomous Serpents being individually very numerous in India, and the population being dense, it is reasonable to expect that great mortality would occur from Snake bites every year. In 1892, 1,455 deaths occurred from Snake bites, and this awful mortality was not compensated by the death of 84,789 Snakes.

The snake-charmers, Fayrer states, handle poisonous Snakes freely, and without fear, even when in possession of their fangs. The Cobras are their favourites, and occasionally the Ophiophagus, as these Snakes present a very striking appearance when they erect their heads and dilate their hoods. Those they exhibit generally have their fangs removed. This is done by cutting out their teeth, and with them the mucous capsule with the reserve fangs. They are exceedingly dexterous, and the sleight of hand with which they appear to catch a Snake in any patch of grass, or even from the ground, is such as to deceive the closest observer. The Snake is, of course, concealed about the person, but is with great rapidity and dexterity placed in the secluded spot, and as quickly abstracted. They are well aware of the danger, and know perfectly well that no antidote has any effect, though they pretend to prevent or cure bites by roots and snake-stones. With venomous they exhibit innocent Snakes, and their exhibition is always accompanied by the music of a rude pipe made of a gourd.

SUB-ORDER COLUBRIFORMES.—THE INNOCUOUS COLUBRIFORM SNAKES.

This great sub-order includes the non-poisonous Snakes, whose jaws are armed with numerous solid, curved teeth. The body is clothed with rows of large scales, and the head has plates. Their negative character is the absence of a decided venom gland. Nevertheless, it is found that in some the last tooth of the upper maxilla is grooved, and may have a small special, but not necessarily venomous gland. Or no gland may be present. In two families, the Rough Tails and the Rollers, the jaws are not extensible, and the prey is small, but in the rest there is much movement possible amongst the bones of the face and side of the head. There are many families of them.

FAMILY ACROCHORDIDÆ.—THE WART SNAKES.

These Snakes from Japan and British India are peculiar, for the body and head are covered with small wart-like tubercular or spiny scales, which do not overlap. The tail is short and prehensile; the eye is small; the nostrils are close together at the top of the snout; and the short teeth are strong and unequal in size on the jaws and palate. They are viviparous Snakes.

One of them,* found in Japan and in Singapore, is very rare. Its habits are terrestrial. Carter compares its head to that of a bull-dog, and a female in his possession brought forth twenty-seven young ones, all alive and anxious to bite. Undigested fruit has been found in the stomach, but the Snake looks as if it fed on prey.

Another species is aquatic, and has a broad compressed tail. It is not venomous, and lives in the rivers and shallow seas of the Indian Archipelago.†

FAMILY DRYIOPHIDÆ.—THE WHIP SNAKES.

These can usually be readily distinguished by their excessively slender back and tail, the head being narrow and long, ending in a protruding rostral shield, or sometimes in a flexible end to the snout. The scales are narrow and overlap much, and the species have the hinder tooth grooved. The body has been compared to the thong of a whip. They are usually of a green colour, and the Asiatic kinds have a horizontal pupil, and prey by night. They move with great grace in the trees, but awkwardly on the ground. Whilst on a branch they can retain their hold with a few coils of the tail, and then their long bodies shoot forth to seize the birds and lizards which for the most part form their food. Some attain a length of seven to ten feet. An Indian Snake (*Passerita mycterizans*) feeds on birds and lizards, and has a long and more or less movable snout. *Oxybelis fulgidus*, from South America, has also this appendage. An offshoot of this family has species which are also nocturnal, with a short broad head, short snout, and vertical pupil. These are the Dipsadidæ, and they are found in India, Africa, and Australia. They live on warm-blooded animals, some attacking birds only, and others mammals. Their colours are more varied than the common Tree Snakes. The Brown Tree Snake is a type, and is found in Eastern Australia, and it is nocturnal in its habits, preying on birds and eggs.‡ The Ularburong of the Malays (*Dipsas dendrophila*) is one of them.

Some other Indian and African Snakes have a body of a moderate length, and a flat muzzle, the small eye having a vertical pupil. They§ are ground Snakes, and those of India live

* *Acrochordus javanicus.* † *Chersydrus granulatus.* ‡ *Dipsas fusca.* § Family *Lycodontidæ.*

on Skinks exclusively, whilst the African kinds devour mice and some other small nocturnal mammals.

Some remarkable Snakes come from Madagascar, and have a long fleshy prolongation to the muzzle at least one-third the length of the head. In one species this appendage is toothed, and in the other it is plain. In the Langaha this growth has the shape of a blade, and is sharp at its end. The colour of the Snake is bright brownish-red; and in the Cockscomb Langaha, the muzzle is dentated, the Snake being brown and yellow. They belong to the genus Xiphorhynchus. The family is represented in Australia.

OXYBELIS FULGIDUS.

A curious Snake of a purplish colour, densely marbled and mottled with brown, with small rose-coloured spots, the cheeks and lips being carnation, has a flat head resembling that of a mastiff in shape. The lips are arched and tumid. It climbs with ease, and frequents, by night, the roofs of the huts of the natives of Java and Borneo, in searching for food, which consists of insects. It attains the length of three feet. This Snake has a slender body, and tail, which is prehensile, but the head is thick and large, and hence it is the type of the Blunt-headed family. They have a very narrow mouth, and the maxillary bone is very short, and is provided with a few small teeth, and the palate and lower jaw have strong teeth in front, but none are grooved.*

* Family *Amblycephalidæ* (Blunt-head Snakes). The species is *Amblycephalus boa*.

FAMILY DENDROPHIDÆ.—THE TREE SNAKES.

These Snakes are diurnal in their habits, living in trees, and are extremely active climbers and movers amongst the boughs, and their colours, often vivid, assimilate with the surrounding foliage. They are found in all the tropical regions, and feed principally on Tree Lizards. The body and tail are much compressed, or are very slender and elongate, and the head is distinct from the neck, and has a longish snout and wide gape.

FAMILY PSAMMOPHIDÆ.—THE DESERT SNAKES.

These have a longish body and tail, sometimes stout and rounded, and the head, very distinct from the neck, is narrow or thick, and the loreal region is very concave. The scales are smooth, the nostril

DIPSAS DENDROPHILA.

is lateral, and the eye is of moderate size. One of the four or five anterior maxillary teeth is longer than the others, and the last is grooved. They are more common in tropical Africa than elsewhere, and some are slender, others being stout. They frequent plains, and live on the ground. There is one Indian species,* and it reaches forty inches in length. Mr. Jerdon noticed one which had killed and was swallowing a small Vipera Echis, and remarks that this is, perhaps, the only instance ever heard of in which a non-venomous Snake overpowered a venomous species. Another, belonging

* *Psammophis condanarus.*

to a second genus,* is very repulsive in its aspect; and its swollen lips, covered by large hidden fangs, give it the appearance of a venomous Snake. It has a wide geographical range in the Himalayas, and the mainland to China, and in the great islands.

THE RACHIODONT FAMILY.

An egg-swallowing Snake is found in South Africa,† and there are several other species of its genus which probably swallow eggs, and have a peculiar structural arrangement in relation to this food. Dr. Smith writes:—"The paucity and smallness of the teeth in the mouth are favourable to the passage of the egg, and permit it to progress without injury; whereas, were they otherwise, many eggs which have thin shells would be broken before they entered the gullet, and the animal, in consequence, would be deprived of its natural food when within its reach. Having observed that living specimens which I kept in confinement always retained the egg stationary about two inches behind the head, and while in that position made great efforts to crush it, I killed one, and found the *gular* teeth about the place where the egg ceases to descend." Those teeth assist in fixing the egg, and also in breaking the shell as the muscles contract around the throat. The instant the egg is broken the shell is ejected from the mouth, and the fluid contents are carried down to the stomach. The so-called *gular* teeth are really the tips of the long inferior spines of eight or nine of the first vertebræ. Their tips are covered with an enamel-like substance which projects through the coats of the gullet, or œsophagus, into its cavity. This is one of the most striking instances of a "final cause" in nature, and the case stands isolated.

There is a family of Fresh-water Snakes‡ which, Günther notices, may be recognised by the position of the nostrils *on the top of the snout*, which enables them to breathe by raising but a very small part of the head out of the water. It is the same arrangement as that seen in the Sea Snakes. There are several genera, and the species are usually small in size. They range widely in British India and the islands of the mainland of Asia. The species *Hipistes hydrinus* greatly resembles a true Hydrophis (p. 310). It lives in the sea, but it is not a venomous kind. The Long-nosed Herpeton, a Fresh-water Snake, is remarkable for having two flexible "feelers," which are as long as its snout. They are probably of use when the Snake is under water. It is found only in the southern parts of Siam.

FAMILY COLUBRIDÆ.—THE COLUBRIDES.

This is a very large family, and the following is a general description of the Snakes which form its numerous sub-families and genera:—The head is distinct from the neck, not very large, and plated. The teeth are numerous, and those of the upper jaw diminish in size from before backwards. The tail has a double row of scales beneath, and there are no vestiges of limbs, nor is the body rigid as in the next family. This important family is subdivided, and contains several sub-families, of which the Smooth Snakes of Europe, the Common English Snake, and Æsculapius Snake, are types, and they are the Coronellinæ, Natricinæ, Colubrinæ, and Dryadinæ. The family is very widely diffused.

SUB-FAMILY NATRICINÆ.

There is a common Snake,§ which frequents many parts of England, and especially places where water is readily reached. By no means uncommon, they are nevertheless rarely seen except by those people who look for them, and, indeed, many of the unobservant live in counties where the Snake is excessively common, and yet never see a specimen. As this Snake is very fond of the water, and swims with ease, and frequents ponds where there are frogs to be caught, it is often called the Water-Snake. It is a slender reptile, with the back part of the head broader than the neck, and the head is rather flattened and ovate in shape. The plates are broad and flat, and there are seven labials. The body is very long, and the middle line of the back is elevated; the tail is tapering and about one-fifth of the entire length. The scales of the back are oval, imbricated, and each has a keel; those of the sides are broader and less keeled. The abdominal plates are broad, and number 170, whilst the sub-caudals are in pairs from sixty to sixty-five in number. The upper parts of the body and head are of a light brownish-grey with a green tinge, sometimes approaching to a dull pale olive. Behind the head, on the upper part, is a broad collar, or two curved spots of a bright yellow

* *Psammodynastes.* † *Dasypeltis scaber.* ‡ *Homalopsidæ.*

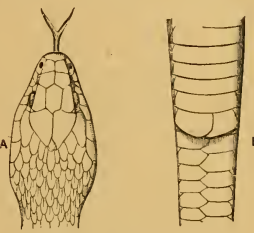
§ *Tropidonotus natrix* (Kuhl); or, *Natrix torquata* (Ray).

colour, and immediately behind these are two broad cross spots of black, or they may be confluent. Two rows of small black spots are arranged alternately down the back, and there are larger ones at the sides, all of which vary in size and closeness. The under part is of a pale blue, dull in colour, or it may be of a lead tint marked with black. It is therefore a pretty slim Snake, which may attain to the length of three or four feet. It has a large mouth, and the gape is of the length of the head, and slightly curved, rising behind. The tongue is long, very flexible, and forked to about one-third of its length. The teeth are small, curved backwards, and arranged, as is usual in the group to which this genus belongs, in two series on each side of the jaw above and below.

COMMON OR RINGED SNAKE.

They like the warm, sunny banks and heaths where the grass is high, near a pond, and bask by the hour together. They slide down a crack, or move rapidly through the underwood, on an alarm. In the water they are very active, and chase frogs and catch small fish; out of that element they are not very particular in their food, and they will strike and swallow young birds, birds' eggs, mice, lizards, and frogs. The female is larger than the male, and she is oviparous, laying eggs a considerable time before the young ones are hatched. They are deposited in a warm place, and are from sixteen to twenty in number, being connected together by a glutinous substance. Towards the end of autumn, or earlier, they resort to some sequestered and sheltered place, as in the hollow roots of trees or under hedges and brushwood, coil up in company with others, and sleep during the winter, hibernating thus until the warmth of spring is pronounced enough. Mr. Bell, in his work on "British Reptiles," says that the Common Snake is easily tamed, and may be made to distinguish the people who caress and feed it.

When hungry, this Snake moves with great rapidity after its favourite prey, and the frog leaps away quickly enough at first, but soon gives up the struggle. It may seize the frog by the hind leg or quarter, and Bell says that the victim stretches itself out convulsively before it is slowly enclosed within the jaws and gradually swallowed. Sometimes the frog is taken by the Snake so that it leaves three limbs out of the mouth, after the body has disappeared, but they gradually move in and down, and the body of the Snake becomes so much the larger as the food moves into the stomach. The author just quoted once saw a frog which had been swallowed by an unusually large Snake, leap out of the mouth of the latter which happened to gape, as they frequently do immediately after taking food. And on another occasion he heard a frog croaking several minutes after it had been swallowed. In taking lizards and birds the Snake swallows them head first. After a meal the Snake remains inactive for many days, and does not seek a fresh meal until the former one has digested. This Snake is, of course, not venomous, and its little bite does no harm to man or child. They change their skins twice or more in the summer, according to the temperature of the air, and the rapidity of growth. This Snake is found in most of the countries of Europe, from Scotland and the corresponding latitude of the Continent to Italy and Sicily. Mr. Bell says that not only is the Common Snake not a native of Ireland, but attempts to introduce it have failed, not from any peculiarity of the climate, or any sacredness of the beautiful green island, but rather owing to the prejudices of the inhabitants, which led to their destruction directly they were introduced artificially.



TOP OF HEAD (A), UNDER PART OF BODY AND SUB-CAUDALS (B), OF COMMON SNAKE.

The genus has an immense range, and the Moccasin Snake, Garter and Ribbon Snakes, are well known in North America. The Hog-nosed Snakes of America (genus Heterodon) and of Madagascar belong to this sub-family.

SUB-FAMILY COLUBRINÆ.

The True Colubrides—sub-family Colubrinæ—afford, according to Günther, the most perfect examples of the innocuous Snake, and they are not characterised by the excessive development of some particular organ, but by the fairness of the proportions of all parts. They are Land Snakes, but they swim well when driven into the water, and they climb in search of food. The genus Coluber is almost world wide, being found in North America, Europe, Asia, and Africa. The Schlangenbad Snakes belong to this genus, and the species was sacred to Æsculapius.

The Snakes of the genus Compsosoma, like those just mentioned, have the maxillary teeth equal in length, and are Indian, the genus Spilotes being their American representative.

The Black Snake* is slender, with smooth lustrous scales. It is black above and blackish-ashy below, with a white throat, and is common in North America. It grows to a considerable size, and is a most active and bold Snake, possessing, moreover, great powers of constriction. Hunting after small birds, it climbs trees easily and robs their nests. In the West it is a persistent enemy of the Rattlesnakes. It hunts them, and boldly seizes them, enveloping their bodies in its constricting folds. It is sometimes included in the genus Coryphodon, which has species in America, Africa, and the East Indies. The Pantherine Snake † of the Brazils is one of its species.

The Indian Rat Snake ‡ belongs to the group, and is very common on the continent of India and Ceylon. It is scarcer in the Archipelago and in the Himalayas, which it ascends to 5,240 feet above the level of the sea. It is a powerful Snake, attaining to the length of seven feet, and its food consists of mammals, birds, and frogs. It frequently enters dwellings in search of mice, rats, and young fowls, and is of fierce habits, always ready to bite, and they are not to be tamed readily.

* *Bascanium constrictor.* † *Coryphodon pantherinus.* ‡ *Ptyas mucosus.*

SUB-FAMILY CORONELLINÆ.

The Ground Colubrides, or Coronellinæ, are Snakes of small size, with smooth scales. They live on the ground, and are generally of rich, brilliant coloration, and only a few which frequent grassy plains are of a bright green colour. The genus Coronella has species in almost every part of the temperate and tropical regions, and there is a doubtful one in India. The European *Coronella lævis* is the type, and is found from Norway to the south. It is possibly an English Snake.

Another genus (Cyclophis) is interesting because it is represented by different species in North America, China, Afghanistan, Mesopotamia, Hindostan, Ceylon, and Assam. They have all the

CORONELLA LÆVIS.

teeth of equal size, and none are grooved. They are small Snakes, and as they frequent grassy places, their colours are principally green and olive. They belong to a sub-family, the Dryadinæ, or Bush Colubrides, some of which have the long body more or less compressed, as it were, but not so excessively slender as the true Tree Snakes. The tail is also long, and the head, distinct from the neck, may have an elongate snout. The All-green Tree Snake of South America * and the Antillean Snake,† with large eyes and elongated scales, have been brought to England. Nearly all the species are arboreal.

* *Philodryas viridissimus.* † *Dromicus antillensis.*

FAMILY CALAMARIDÆ.

This is a family of small Snakes with rather rigid, cylindrical, elongated bodies terminating in a short tail, and they are called Dwarf Snakes. The head is but slightly distinct from the neck, and the small nostrils are lateral, and some of the head-shields are united, so that in some species there are two pairs of frontal plates, and in others but one. The body and tail scales may be smooth or keeled, and are in from thirteen to seventeen longitudinal series.

The White-bellied Dwarf Snake* may be taken as the type of the genus Calamaria. It has a single pair of frontal plates and thirty rings of scales, those under the tail being double. This little Snake is about eleven inches long. The head is brown, and the body, of the same colour, is ornamented with four longitudinal marks on the side and beneath. There is much white colour beneath. It is an East Indian form, and lives on small mammals and worms, and is, perhaps, the most fragile of all Snakes, and it falls a victim to Bungari and other Snakes.

In the family Oligontidæ there is a peculiarity about the dentition, one of the genera having no palatine teeth,† and another having the last tooth of the upper jaw longer than the others, and sometimes having a groove in it.‡

FAMILY PYTHONIDÆ.—THE ROCK SNAKES.

These reptiles are occasionally found of great size, and are the largest of the Snakes. They are fortunately not common, and yet they have a very wide and somewhat remarkable geographical distribution. They are found in the hottest parts of Africa, Asia, the Eastern Archipelago, and Australia, according to Günther, and thus link together those distant lands in a former continental space. For the Pythons, although liking water and swimming, could not, and do not, pass from land to land by sea; and, therefore, the ancestors of those in the separated districts were once free to invade over the ancient and now partly sunken intervening lands. Living to a great age, having few enemies, except man, they reach the length of thirty feet, and have the circumference in their largest part of that of the body of a man. But those having the length of from eighteen to twenty feet are rare, and the commonest are found within that length, and their thickness is that of a man's thigh. Climbing as well as swimming, and able to move rapidly over the ground, the Rock Snakes, constituting the genus Python, attack animals such as small deer and others of the same size, and birds. They seize their prey after the fashion of other non-venomous Snakes, with their teeth, and then coil their body round it in a few or several folds, crushing and smothering it. They occasionally kill larger animals than they can swallow; but when one is within their coils which can be got down, the head of the victim is taken in first, and then the rest follows slowly; and the passage, often difficult enough in consequence of the size, hairs, horns, or feathers, is assisted by the production of a lubricating saliva. It is a curious sight to see a couple of ducks seized one after the other and bolted by a captive Python, and it is evident that after the meal the creature becomes very disinclined to move. In a state of nature, if a large animal has been swallowed, the Python becomes torpid and may be easily killed. They have the character of being fierce, and of showing great determination when brought to bay. They grow slowly, and one which was brought to London having a length of eleven feet, attained twenty-one in ten years; but the growth is quicker in the early periods of life, this eleven-foot specimen being about four years of age. The males are smaller than the females.

There are two species of Python in India. One is common in the Archipelago, inhabiting most of the islands, and feeding on quadrupeds and birds. It often takes up its abode in outhouses, catching its prey at night, and is useful in destroying vermin, although it occasionally causes havoc amongst poultry. Very fond of water, it usually reaches a length of sixteen feet, but some of thirty feet have been seen. It is the Ular sawa of the Malays. § The other one is the Adjigar of the Hindoos. ‖ This great Snake has been said to destroy a Buffalo, which it certainly could not swallow; and there is a well-known engraving representing a man seized by one of these monsters.

There are two Pythons from West Africa, and one of them ¶ is to be seen in the Zoological Gardens of London; and when in full vigour, after having cast its skin, is iridescent with rainbow

* *Calamaria albiventer.* † Genus *Oligodon*—Java and Ceylon, India.
‡ Genus *Homalocranion*—North America and Venezuela. § *Python reticulatus.* ‖ *Python molurus.* ¶ *Python sebæ.*

tints on its grey body. It closely resembles the Natal Python, which Dr. Andrew Smith describes as occasionally reaching twenty-five feet in length. It may be the Indian species last alluded to. Formerly an inhabitant of the Cape Colony, it is now not to be found for hundreds of miles from its boundaries, and few specimens have been found nearer than Port Natal.

Dr. Sclater, F.R.S., has shown that the African Python* and the Indian Adjigar† incubate their eggs. These are of the size of those of a goose, and fifteen were laid on a 6th of May.

INDIAN ADJIGAR.

The Snake (the African one) collected them in a conical heap, coiled herself round and on it, entirely covering the eggs, and her head rested on the top of the cone. The Snake remained in that position until eight of the eggs were hatched on the 3rd of July. An increase in the temperature of the Snake has been observed during the hatching. The Snakes of this family have the relics of hind limbs in the shape of bony spurs, and the tail is prehensile; it enables the Python to cling on to the stump of a tree or a rock whilst arresting the escape of the prey. The head has

* *Python sebæ.* † *Python molurus.*

BOA CONSTRICTOR.

(*From the Living Specimen in the Zoological Gardens, London.*)

rather a long snout, depressed and cut short, or rounded in front. The eye is of moderate size, and the pupil is vertical. The scales are smooth, very numerous in series, and the sub-caudals are two-rowed. None of the teeth are grooved, and they are found in the intermaxillary, maxillary, palatine, pterygoid, and mandible bones, and they are unequal in size.

Associated with the Pythons, which are the types of a sub-family, are some beautiful Australian Snakes, which are usually said to belong to two species, the Diamond and Carpet Snakes, but which in all probability are races, or local varieties of one.*

The next sub-family of the Pythonidæ to be considered is that of the Boas, and they have the

DIAMOND SNAKE.

general configuration of the Great Pythons, but some have the head scaly and without plates, whilst others have irregular plates. In all the tail is prehensile, but the intermaxillaries have no teeth. All are South American, except some belonging to a genus whose place in classification is uncertain, and whose species live in Java.

The Boa Constrictor has a long scaly head, which is broad behind, and the tail has a single row of sub-caudal scales. They are arboreal, and watch for their prey, swooping down on it head first, seizing and coiling their long and stout body around it. They reach twelve feet in length as a rule, and it is said that some are twice and more as long, but there are grave doubts about the truth of the statement. The ornamentation is rather peculiar, and there is a long series of markings extending the whole length, composed alternately of great blackish stains or spots irregularly hexagonal, and of pale oval stains or spots notched or jagged at either end, the whole forming a very elegant pattern. It has the habits of the family, and is restricted to the tropical parts of South America. Probably

* *Morelia argus* and *M. variegata.*

this was the Snake which was worshipped by the natives, and it has a strange literature attached to it, of stories of the most wonderful kind, and it has been confounded with the Anaconda, which forms the next genus of the sub-family.

Bates once, on an insect-hunting expedition, met a Boa Constrictor face to face. The huge Serpent was coming down a slope, and making the dry twigs crack and fly with its weight, as it moved over them. He knew there was no danger and stood his ground, and the reptile suddenly turned and glided at an accelerated pace down the path. The rapidly-moving and shining body looked like a stream of brown liquid flowing over the thick bed of fallen leaves rather than a Serpent with a skin of varied colours. One morning, after a night of deluging rain at Pará, the lamplighter, on his rounds to extinguish the lamps, knocked Bates up to show him a Boa Constrictor he had just killed in the street not far off. He had cut it nearly in two with his knife as it was making its way down the sandy street.

The ability of Snakes to swallow prey, the size of which is greater than that of their heads and necks, might be called in question were it not a very familiar spectacle. Whether the victim has been struck and poisoned, or bitten and enfolded in some twirls of the body, or simply caught in the mouth, sooner or later it is forced within the jaws, and the skin of the head is greatly distended. The crooked shape of the teeth prevents the return of the prey, which is forced farther and farther back, by alternate forward movements of the movable and separable lower jaws, by gapings and general forward movements of the jaws. As the prey gets beyond the middle of the mouth the lower jaws are separated behind from the skull, as much as possible, by the mobility of the quadrate and squamosal bones, and then the extensile gullet receives its morsel. Once past the jaws, the muscular efforts are restricted to the gullet and body.

A clean skull of a Python, with its bones in their proper place, shows how solid is the brain-case, and how movable are the jaws and their attached bones. On looking at this Snake's skull the pre-maxillary bones are seen in front, and there are teeth in them. This is (with the exception of the genus Tortrix) not the usual arrangement, for teeth are wanting there in other Serpents.

Then the maxillary bones (on each side) are large, long, arched, and many-toothed, and very different in shape to those of the venomous Snakes. Within the mouth, and on the palate, is the palatine bone (of each side), also furnished with teeth, whose points look backwards, and the bone is long and is united behind with the pterygoid. Just where they unite a bone passes out to join the maxilla, and this is the transverse bone. The hinder end of the pterygoid bone is in contact with the quadrate and squamosal bones. This last bone (squamosal) is long, and only adheres to the skull by one end, the opposite or outer end being in contact with the quadrate bone. Hence the quadrate bones can be stuck out from the skull by their own and also the length of the squamosal. On looking at the lower jaw the parts at the chin are noticed to be capable of wide separation there; and behind, the mandibles jointed to the quadrate can be forced as widely apart as that bone and the squamosal will let them. Hence the space through which the prey can pass is wide. In the Tortrix (p. 335), which has the exceptional pre-maxillary teeth, the quadrate bone is articulated directly with the skull, the squamosal being rudimentary. So it cannot bolt great morsels.

The great water-loving Snake of Brazil, about which so many wonderful stories have been told, is the Anaconda,* and it has often been confounded with the Boa Constrictor. Its head is furnished with irregular plates, and that of the Boa is simply scaly. It grows to a great size, however, and a large specimen is usually to be seen in the Zoological Gardens of London. Lying in great coils, with the scales iridescent after it has cast its skin, this Snake may be seen with its prey—a couple of ducks—in its lively moments. Often, however, it is wonderfully inert, and the birds even rest on it and *quack, quack*, with full tones. Sooner or later, however, a long head, rather wide behind and with a notable set of teeth, moves upwards out of the coil, and there is a rush forward, and a duck is caught. Soon it disappears down the stretched-out mouth and throat, and the other one follows after an interval. They last long, indeed many months, without food, and in their native home live in and about rivers and swamps, preying on birds and small mammals.

* *Eunectes murinus.*

The sub-family of the Boas also contains the Tree Boa of South America,* Mexico, and the West Indies, and two other genera of West Indian Snakes. These are represented by the Pale-headed Tree Boa of Cuba† and the Yellow Snake of Jamaica.‡

FAMILY ERYCIDÆ.—THE SAND SNAKES.

These resemble the Pythons and Boas in their internal and in most external characters, but their tail is short and not flexible or prehensile, and the head is hardly distinct from the neck. They are not arboreal, but frequent sandy or dry places and plains, burrowing easily beneath the surface, and entering crannies and holes in search of their prey, which consists of mice, lizards, and other burrowing snakes. They move with great rapidity. They are nocturnal, more or less, and are found in Northern Africa, South Europe, and the islands of the Mediterranean, Asia Minor, Hindostan, Sikkim, and part of Arabia.

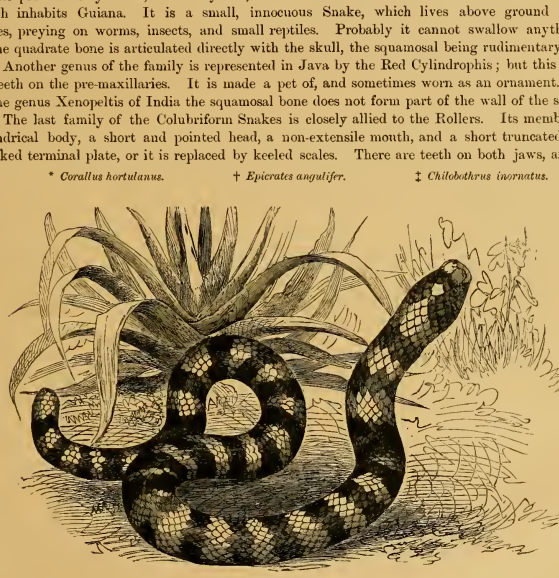
THE FAMILY OF SHORT-TAILED SNAKES, OR ROLLERS.—THE TORTRICIDÆ.

The Snakes of this family are cylindrical in shape, and rather rigid in their bodies. They have a small, conical, stumpy tail, a short and indistinct head, and little teeth, some being on the palatine bones, and the scales are smooth. They have a rudimentary pelvis with horny spines projecting close to the vent, and there are relics of the hind limbs. One species has teeth on the pre-maxillary bones, like a Python, as well as on the usual bones. This is *Tortrix scytale*, which inhabits Guiana. It is a small, innocuous Snake, which lives above ground in boggy places, preying on worms, insects, and small reptiles. Probably it cannot swallow anything large, as the quadrate bone is articulated directly with the skull, the squamosal being rudimentary.

Another genus of the family is represented in Java by the Red Cylindrophis; but this Snake has no teeth on the pre-maxillaries. It is made a pet of, and sometimes worn as an ornament. Finally, in the genus Xenopeltis of India the squamosal bone does not form part of the wall of the skull.

The last family of the Colubriform Snakes is closely allied to the Rollers. Its members have a cylindrical body, a short and pointed head, a non-extensile mouth, and a short truncated tail, with a naked terminal plate, or it is replaced by keeled scales. There are teeth on both jaws, and there is

* *Corallus hortulanus.* † *Epicrates angulifer.* ‡ *Chilobothrus inornatus.*

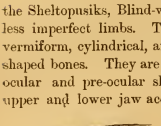


TORTRIX SCYTALE.

a fold in the throat which permits of the extension of the skin. The eyes are very small. These Uropeltidæ, having such remarkable Saurian affinities, live in the East Indies and in Ceylon, and it is necessary to dig to a depth of four feet to obtain them.

SUB-ORDER TYPHLOPIDÆ.—THE BLIND SNAKES.

These are small Snakes, and are by no means readily distinguished by an ordinary observer from the Sheltopusiks, Blind-worms, Amphisbænæ, and other Lacertilia with Snake-like bodies, and more or less imperfect limbs. They lead a life like that of the burrowing Anguis (p. 297), their bodies are vermiform, cylindrical, and rigid, and there are the relics of hind limbs in the form of small rod-shaped bones. They are not blind, for the eyes are present, although small, but they are covered by the ocular and pre-ocular shields, which are more or less transparent. The teeth are found in the upper and lower jaw according to the genera. These Snakes are allied to the Lizards in that they have the long axes of the palatine bones transverse, and there is no transverse bone as in the Snakes proper. Moreover, the pterygoids are not connected with the quadrate bone. They have not the power of enlarging their narrow mouth, and they feed on small worms and insects. They are divided into two families: in one, the Catodontes, there are teeth only on the lower jaw, which is shorter than the upper;* in the other, the Epanodontes, the teeth are on the upper jaw, and the extremity of the muzzle is truncate and covered with large scales, the nostrils being situated laterally on the anterior margin. *Typhlops lumbricalis*, of the Antilles, is the type. Some other small Blind Snakes, with the rudiments of hind extremities hidden beneath the skin, and a small eye covered by the ocular and pre-ocular shields, are inhabitants of almost every part of the Tropics, and about eight species occur in British India, and the most remarkable is *Typhlops tenuis*.



SIDE VIEW OF HEAD OF BLIND SNAKE. (*After Günther.*)

The Australian Blind Snake is *Typhlops ræpelli*, and it lives in ants'-nests.

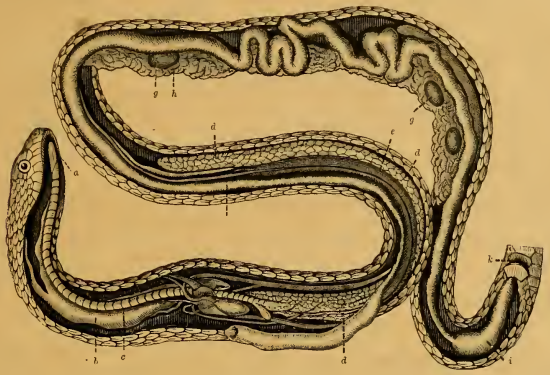
In concluding this natural history of the Serpents it is necessary to make a few remarks on some of their more important peculiarities of structure. The tongue, that long, rapidly-moving organ, which is evidently often used as a feeler, as well as a menacing agent, is slender, cylindrical, and forked. It is lodged in a membranous sheath, the opening of which is situated near the anterior part of the mouth, and the reptile can protrude it from the mouth to nearly its whole length. The œsophagus and stomach form a continuous tube of variable length, and it is difficult to determine where one ends and the other begins. But the stomach is strengthened by muscular layers, and the folds in it are more numerous. It is short in relation to the length of the reptile, and any large prey is retained partly in the œsophagus. There are two parts, one of which, in front, is the "sack," and the other the pyloric end, and this is more or less bent on the other. It has no folds, and has to deal with the more or less digested food. The intestine is much looped in the True Serpents, and this seems to refer to the movement of the reptile on its belly, and the possibility of this acting perniciously on a simple elongated gut. That of the Water Snakes is simpler. They all have a lobed liver, a spleen, and a pancreas.

They have a complicated lymphatic system, and there are lymphatic hearts situated just above the origin of the tail, and they are large in the Python. A diminished and atrophied condition of one of the lungs has already been noticed in some Lizards, and it is found in the Serpents, and has to do with the room which great prey requires when swallowed. It is not necessary to refer to the circulation, except to notice that the ventricular septum is incomplete. The great nervous centre has the two hemispheres broader than long, the olfactory bulb is frequently of large size, and the corpus striatum is smaller than in the Lizards. The cerebellum is very small and flat, and the so-called bigeminal tubercles are well developed.

In the ear there is no proper tympanic cavity, and the handle of the auditory ossicle is embedded amongst the flesh, so that its extremity only touches the skin, close behind the articulation of the jaw.

* *Stenostoma nigricans*, an African species, is the example.

The eye of Serpents is protected by an eyelid of a very remarkable character; for that it is an eyelid, and not, as is very generally supposed, the cornea, its anatomical relations abundantly prove. It consists of a transparent membranous expansion, which is immovably fixed in a kind of frame formed for its reception by a circle of scales, usually seven or eight in number, disposed around the margin of the orbit. This eyelid is formed of three superposed layers. First, an epidermic layer which is elastic and pretty thick where it covers the middle of the eye, but towards the circumference of the eyelid it becomes thinner, and is manifestly continuous with the epidermis that invests the scales in the vicinity of the orbit. This corneous lamella, by its solidity, is well adapted to defend the eye, and it is this which becomes detached and cast off with the slough of the Snake when it moults its skin. Secondly, beneath this epidermic layer is a second membrane, which is the middle tunic of the eyelid. This is very delicate and soft, and perfectly transparent in the centre, but towards



VISCERA OF A SERPENT.

(*a*) Mouth; (*b*) Gullet; (*c*) Trachæa; (*d*) Lung; (*e*) Liver; (*f*) Stomach and Intestine; (*g*) Egg; (*h*) Ovary; (*i*) Cloaca; (*k*) Vent.

its circumference it encloses some opaque whitish fibres, supposed by Cloquet to be muscular. This layer, at the margin of the orbit, is manifestly continuous with the skin; internally it is lined by the third layer, which is mucous, being, in fact, the membrana conjunctiva, which is reflected on to it from the surface of the eyeball. All around the circumference of the eyelid there is a whitish, granular, transparent substance, the nature of which is apparently glandular.

The conjunctiva lines not only the internal surface of the eyelid, but also a large portion of the cavity of the orbit, from which it is reflected on to the front of the eyeball, thus forming a complete sac without any opening externally.

The skin comes off the eye during the periodical moult of the cuticle of the body, and for some little time before it looks dull and discoloured; and when it has been cast, the new covering is perfect in its transparency.

During the moult the Snakes hide up or are quiescent, and the whole skin comes off in one or more pieces.

In conclusion, it may be remarked that the Ophidia have not a great geological age, and the first lived in the early Tertiary age. The remains of a Snake belonging to the Python group, twelve feet in length, were discovered at Sheppey; others of a Boa, twenty feet in length, came to light at Bracklesham. The vertebræ are perfect, and they belong to the fossil genus Palæophis. Others were found at Hordwell in higher strata. In later Tertiary deposits the presence of a

venomous Snake has been noted, and a vertebra of a huge Coluber was found in the Miocene of the South of France. In the fossiliferous deposit at Œningen three species of Coluber have been found.

The fossil remains of Serpents in North America occur in lower Tertiary deposits. The genus Dinophis was one of the Sea Snakes, and the species attained the length of thirty feet. Snake remains are abundant in the fresh-water Eocene deposits of the Western States, but they are of moderate size. They are related to the Boa Constrictors and others. A few fragments have been found in later deposits. There are a few remains of fossil Snakes in the Tertiaries of India.

CLASSIFICATION OF THE ORDER OPHIDIA.

	Sub-Order.—Thanatophidia (Venomous Snakes).		
Family	Elapidæ.—Venomous Terrestrial Colubrines	Example—Genus	Naja
,,	Hydrophidæ.—Venomous Water Colubrines	,,	Pelamis.
,,	Solenoglyphia.—Viperine Snakes } Sub-Family Viperidæ.—Vipers }	,,	Pelias.
	Sub-Family Crotalidæ.—Pit Vipers	,,	Crotalus.
	Sub-Order Colubriformes.—Innocuous Colubriform Snakes.		
Family	Acrochordidæ.—Wart Snakes	Genus	Acrochordus.
,,	Dryiophidæ.—Whip Snakes	,,	Passerita.
,,	Dipsadidæ.—Nocturnal Tree Snakes	,,	Dipsas.
,,	Lycodontidæ.—Ground Snakes	,,	Lycodon.
,,	Amblycephalidæ.—Blunt-heads	,,	Amblycephalus.
,,	Dendrophidæ.—Tree Snakes	,,	Bucephalus.
,,	Psammophidæ.—Desert Snakes	,,	Psammophis.
,,	Rachiodontidæ.—Throat-toothed Snakes	,,	Dasypeltis.
,,	Homalopsidæ.—Fresh-water Snakes	,,	Hipistes.
,,	Colubridæ.—The True Snakes	,,	Coronella.
	Sub-Family Natricinæ.—Ringed Snakes	,,	Tropidonotus.
	,, Dryadinæ.—Bush Snakes	,,	Herpetodryas.
	,, Calamaridæ.—Dwarf Snakes	,,	Calamaria.
Family	Pythonidæ.—Rock Snakes	,,	Python.
,,	Erycidæ.—Sand Snakes	,,	Eryx.
,,	Tortricidæ.—Rollers	,,	Tortrix.
,,	Uropeltidæ.—Rough Tails	,,	Uropeltis.
	Sub-Order Typhlopidæ.—Blind Snakes.		
Family	Catodontes	,,	Stenostoma.
,,	Epanodontes	,,	Typhlops.

THE EXTINCT REPTILES.

In describing the Chelonia, Crocodilia, and Ophidia, attention was paid to the kinds which lived in ages gone by. It is now necessary to draw attention, very briefly, to the Fossil Reptiles, which cannot be exactly classified in the same great groups as those now mentioned, and also to those which may, with greater or less propriety, be connected with the Sauria or Lacertilia. They have been found in the Permian deposits, and in those of the consecutive ages to the Pliocene, but the Trias, Lias, and Oolitic strata in the Old World, and the Cretaceous strata of the Old and New Worlds, contain the greatest number, and the structural affinities of the extinct kinds with the recent, and with Fish and Birds, are very remarkable.

THE DINOSAURIA.

These reptiles attained the greatest size of any animals living on land, but some of them were mere pigmies. Thus, the Iguanodon of the English Wealden had a thigh-bone four feet in length, a Cetiosaurus found in the Oolites must have been ten feet in height, and the American Titanosaurus was no less than sixty feet in length and thirty feet in height. On the other hand, Nanosaurus, an associate of the other and greater one, was no larger than a Cat. They began to live in the age of the Trias, and died out in the Cretaceous age, and had a vast geographical range. Most of the kinds walked mainly on their hind feet, like modern Ostriches, and many left the impression of their bird-like feet on the rocks. They had small fore-limbs, and a large tail. They were herbivorous as a rule, but there was a carnivorous group also. A genus was found preserved in the Solenhofen slate called Compsognathus, and it has some of the parts of the skeleton transitional between the Wingless Birds, the Crocodilia, and the Sauria. Some had Crocodile-like heads, with beaks and teeth like a Lizard (*Iguana*), and others had recurved, serried, huge teeth and shortish heads. The Solenhofen specimen had a very bird-like head with teeth, a long neck, short fore and long hind limbs.

The vertebræ differ much in this group in size and number. As a rule the bodies were slightly concave before and behind, or nearly flat; but in some instances the cervical vertebræ were hollow behind only, the dorsal were flat, and those of the tail amphiccelous. Chevron bones were attached between the tail vertebræ; and the sacrum appears not to have been formed by less than four vertebræ. These reptiles had long narrow scapulæ, no clavicles, and the coracoid was rounded. The femur is bird-like at its farther end, and the inner and outer digits are either shorter than the rest or quite rudimentary; and the third digit is the longest, as in the birds in general (Huxley). The bones of the pelvis were much like those of birds.

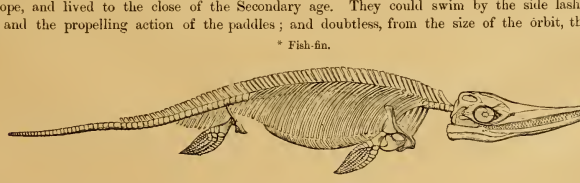
THE ORNITHOSAURIA.

Flying reptiles, but not fashioned on the principle of the modern little Dragon, existed in the Secondary age of the world, and must have been common in Europe and America. The largest had a spread of wing of from ten to twenty-five feet, and were found fossil in the remains of the inland Cretaceous sea of North America. Smaller than these, but furnished with teeth (which the others had not), were those of Europe, some of which were as large as the Albatross, and others no larger than a Blackbird. The American kinds are called Pteranodontia, and the European Pterodactyles. In some of the European kinds there were no teeth in the front of the jaw, and the others were implanted in sockets, but there was a beak (Ramphorhynchus). This kind had a very long tail. In others (Dimorphodon), the front teeth were large and pointed, and the others small. The true Pterodactyles had short tails, teeth throughout the jaws, and the little finger with four long joints. A membrane was attached to them, to the fore arm, to the flanks of the body down to the tail, and it stretched thence to the ankle, and passed over to the end of the little finger. No other fingers were included in the great skin wing. No feathers existed, but the limb-bones were hollow and light. The breast-bone had a keel like the flying birds, and there was a scapula, and also a coracoid very bird-like. The head had great orbits, and was long and light, and a ring of sclerotic plates was on the eye. The brain-case was like that of the bird. They lived in the age of the Lias to that of the Cretaceous inclusive.

THE ICHTHYOPTERYGIA.

An order of extinct reptiles, the Ichthyopterygia,* contains gigantic massive forms which combined a fish and lizard-like construction, and were highly predaceous. They had a long head, a very indistinct neck or fish-like body, and a long tail. The body was covered with skin, and not with scales or plates, and there was probably an upright fin on the tail, which added to the compressed look of the body. Huge eyes, whose sclerotic had many bony plates, were placed at the side of the head; and the gape was wide, the teeth long and stout, and not planted in sockets, but in a common groove. They breathed by means of lungs, and the ribs were numerous, false ones being developed on the under part of the abdomen. The vertebræ were very numerous, and the bodies biconcave, and the neural arch was united to them by a distinct suture. There were neither sternum nor sternal ribs, and the sacrum consisted of two vertebræ; but scapulæ, coracoids, clavicles, and interclavicles existed. The fore and hind limbs were in the form of paddles, the digits consisting of numerous groups of five, with extra or marginal bones. The similarity of these in plan to those of the Cetacea or Whales is very remarkable. These reptiles attained a vast size, and flourished especially in the Lias of Europe, and lived to the close of the Secondary age. They could swim by the side lash of the tail and the propelling action of the paddles; and doubtless, from the size of the orbit, the large

* Fish-fin.



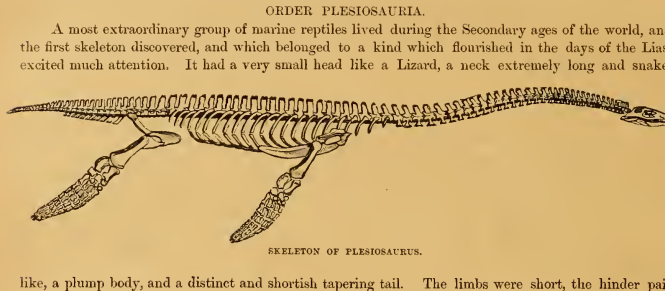
SKELETON OF ICHTHYOSAURUS

eye could collect the feeblest rays of light when chasing prey under water. They appear to have beached themselves occasionally on shore, but they could not walk. Professor H. G. Seeley, F.R.S., has shown, by good evidence, that they were viviparous. They do not appear to have bred in the American seas of the age. There were many species of the genus Ichthyosaurus, and they have the nostrils high up in the snout near the orbits, and their opening in the palate was behind the long palate bones.

Professor O. C. Marsh has founded a new order of extinct reptiles, the Sauranodontia, from specimens obtained in the Jurassic strata of the Rocky Mountains. They were apparently Ichthyosaurs which had no teeth, the jaws being even destitute of a groove for holding them. All the other peculiarities of the Ichthyosaurs (which have, as yet, not been found in America) are present, and their length was from eight to nine feet.

ORDER PLESIOSAURIA.

A most extraordinary group of marine reptiles lived during the Secondary ages of the world, and the first skeleton discovered, and which belonged to a kind which flourished in the days of the Lias, excited much attention. It had a very small head like a Lizard, a neck extremely long and snake-



SKELETON OF PLESIOSAURUS.

like, a plump body, and a distinct and shortish tapering tail. The limbs were short, the hinder pair being the longer, and they were furnished with paddles, differing somewhat from those of Ichthyosaurus. Dr. Buckland compared it to a Turtle with a Snake drawn nearly through it. The Plesiosaur, as it was called, swam probably on the surface, and fed like a Swan, but most likely on fish and small reptiles. It had no scales, but probably a smooth skin. There were no fins; and the teeth, as seen in the preserved fossil skulls, are sharp-pointed, curved backwards, and each is placed in a distinct socket, but it does not unite to the jaw by a bony union. The snout tapers, and is flattish, and the orbits are large, but the eye had no sclerotic plates. The outer nostrils open just before the eyes, and the premaxillary bones, usually small in reptiles, are large, and form a large portion of the snout. The inner nostrils appear to be in front of the palate bones, and are separated by the vomers. The head, not much more than one-twelfth part of the length of the body, moved readily by a large condyle on the very movable neck, which has in some kinds more than forty vertebræ. These are faintly biconcave, and the neural arch is not united by bony union. Some ribs, not unlike those of the Crocodile, exist near the root of the neck, and in the body there are transverse processes with curved ribs jointed to them. There are from twenty to twenty-five back vertebræ, and two sacral, whose ribs are broad for the attachment of the ilium. Thirty or forty tail vertebræ succeed, and they have chevron bones. There are thus ribs to the vertebræ, and there are none to the sternum, and this is compensated by a system of ossifications in the walls of the abdomen, arranged in cross rows, each consisting of a middle bone slightly bent on itself, and of six others, three on each side, their pointed ends overlapping. The arrangement of the bones of the shoulder and chest is very remarkable. The sternum is small and band-like, its place being occupied, as it were, by two great coracoids. The blade-bones, small and long, differ from those of any other reptile, and there is an epicoracoid. No clavicles exist, but in some kinds that lived during the Trias they are found. The fore limb ends in five digits, composed of metacarpals and phalanges constricted in the middle, which are numerous in the middle digits. The pelvis is large, to fit the corresponding large limb, and all the bones are present. The femur much resembles the humerus, and the toes those of the fore limb.

All the extremities were encased in flesh and skin, like the flippers of Whales. These fast-swimming surface skimmers began in the Trias, and the early kinds, such as Notosaurus, differed somewhat from those which followed, or the genera Plesiosaurus and Pliosaurus. The first has been described, and the kinds of the other differ, by having the vertebræ wide in proportion to their length, and deeply excavated before and behind. The head is bigger, the neck shorter, and the paddles are larger.

The American forms belong to the last-named genus; and the first was represented in the Southern hemisphere in Secondary strata in New Zealand.

THE EXTINCT SAURIA, OR LACERTILIA.

It was noticed, in describing the remarkable Lizard from New Zealand—the Tuatéra, or Sphenodon—that it was allied to Rhynchosaurus and Hyperodapedon, Triassic forms.

Other extinct Lizards of small size, whose anatomical characters resemble in many important points those of the Lacertilia with amphicœlous vertebræ, like the Gecko, have been found in the strata of the early Secondary ages. Telerpeton, from Elgin in the Trias, is one of these, and the group are called the Homæosauria. The Eocene Lake basins of Western North America contain numerous fossil remains of Lizards. Some have a bony coat of mail, others are scaly, and a few somewhat resemble the Iguana. Others were found in the Miocene and Pliocene deposits.

The Protorosauria are the oldest of the Lizards, and the remains of one, six or seven feet in length, with a long neck and moderate-sized skull, a long and slender tail, and its limbs as well developed as they are in existing Monitors, were found in the Permian deposits of Thuringia. It had very few cervical vertebræ, all of which are slightly amphicœlous. The teeth, sharp pointed, were implanted in sockets, and its extremities had five digits, which were arranged like those of the Geckos. Another, called Bathygnathus (deep jaw), is from the Trias of Prince Edward's Island.

Owen described a fossil Lizard from the Cretaceous with a long neck and body like an eel, and with limbs. It is called Dolichosaurus longicollis.

He has also described, from South Africa and Hindostan, a form with two huge upper teeth like tusky canines not unlike those of the Morse (Vol. II. p. 212). The lower jaw was armed with a cutting horn, and the reptile swam well. This Dicynodon is of the age of the Permo-Trias, and it belongs to a family—the Dicynodontia. Closely allied are the Cryptodontia, whose teeth are either inconspicuous or absent, such as the genus Oudenodon of South Africa. The Cynodontia, a South African family, is of late Palæozoic and early Secondary age, and there is a pair of teeth in each jaw like the canines of carnivorous animals, and they divide incisors from molars. Galæosaurus is the most remarkable.

Owen has also described a huge Lizard from the latest Australian deposits. Its skull has horns, and belonged to a form which was somewhat like *Moloch horridus*, and was as large as an ox.

The Mosasauria were Lizards; they were great, long-bodied, and some, very Snake-like marine creatures. They are found in the Cretaceous deposits of Europe, and Maestricht yielded the first. It had eighty-seven procœlous vertebræ, and the skull was not unlike that of an Old World Monitor; but the sharp recurved teeth were anchylosed to the pre-maxillary, maxillary, pterygoid, and dentary bones, and the pterygoid bones are unlike those of any recent kinds. There were North American kinds of this group of vast size, which had four paddles, a vast number of vertebræ and ribs, and teeth big enough to vanquish all enemies. They abounded in the Cretaceous seas of the Far West, and some reached the length of sixty feet.

P. Martin Duncan.

Note.—The tooth and part of the skull of a Dicynodon have been found in Triassic strata near Elgin. The Beaked Lizards of the Acrodont group have been found fossil in the Trias at Elgin and elsewhere (see p. 290).

CLASS AMPHIBIA.

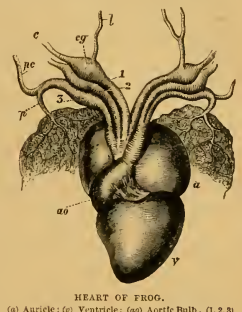
CHAPTER I.

FROGS AND TOADS.

Characteristics of Amphibians—Remarkable Skin—The Skeleton—Heart of Frog—Circulation of the Blood—Method of Respiration—Gills, or Branchiæ—The Nervous System—Brain of Frog—The Eyes and Ears—Alimentary Canal—THE ANOURA, OR THE FROGS AND TOADS—Distinctive Features—Hibernation—Lungs—Throat sacs—Teeth—Food—Skeleton—Muscles of Thigh and Leg—Batrachian Locomotion—Their Swimming Powers—The Tongue—The Croakings—Metamorphosis of the Frog—Structure of the Tadpole—Circulation of Blood in the Gills—Last Stages of the Tadpole Condition—THE BATRACHIANS WITHOUT TONGUES—The Surinam Toad—Birth of the Young Pipas—THE BATRACHIANS WITH TONGUES—THE OXYDACTYLA—THE RANIDÆ, TRUE FROGS—The Common Frog—Habits—Its Relations with Humanity—Development of the Embryo—The Frog's Skull—The Edible Frog—The American Bull Frog—African and other Frogs—The Horned Ceratophrys—THE PELOBATIDÆ—The Obstetric Frog—The Bombinator Igneus—The Brown Mud Frog—The Globose Cacopus Frog—THE BUFONIDÆ—The Common Toad—Habits—The Metamorphosis—The Toad has not Escaped Calumny—The so-called Venom—The Natter-Jack, or Rush Toad—The Variable, or Green Toad—The Indian and African Toads—Mr. Darwin on a South American Toad—The North American Toads—The Breviceps—THE DISCODACTYLES—THE TREE FROGS—The Hyloranæ—The Hylidæ—Their Digits—The Common Hyla—The Goose-footed Hyla—The Elegant Hyla—The Common Golden Tree Frog—The Pouched Frog—The Common Indian Tree Frog—The Spurred Tree Frog—Tree Frogs of Ceylon—The Acris gryllus—The Genus Rhacophorus—The Hylodes ocularis—The Martinique Frog—The Phyllomedusidæ—The Great Green Tree Frog—The Dendrobatidæ—The Genus Plectropus.

THE vertebrated animals called Amphibia were, as has been already noticed in the Introduction to the Reptilia, formerly included with the Reptiles in a great division of the animal kingdom; now they are placed in a class by themselves, and they have many structural resemblances to the Fish. They are cold-blooded, and their skin is generally naked. They have limbs (with few exceptions), and breathe by means of lungs, or they have more or less persistent gills. Their circulation is incomplete in comparison with that of the Vertebrata already noticed, and the skull joins with the first vertebra by means of two occipital condyles. Finally, the Amphibia, with few exceptions, have an immature or a larval and an adult condition, the first being passed in water, and certain membranes are deficient in the embryo, or unborn. The general shape of the Amphibia indicates that they are fashioned to exist, at some time of their lives, in water and on land, and the body is long and cylindrical, or short and compressed, and frequently there is a long, flat tail, and a back crest of skin. Sometimes there are no limbs—for instance, in the worm- or snake-like Cæcilias; in other instances, as in the Siren, there are only short fore limbs, or else the rudiments of fore and hind limbs furnished with weak and limp digits. Even in those kinds which have the limbs and digits well developed, they act principally in pushing the heavy, low body along on the feet. The Batrachians—Frogs and Toads—which have short trunks, tailless in adult age, are the only Amphibia which have two pairs of long and useful active members, which enable their possessors to run, jump, swim, and climb. The skin is of vast importance to the Amphibia as a secreting and a respiratory surface, and it is usually smooth and clammy, or viscid; but the Cæcilias alone, amongst existing Amphibians, have small scales or scutes imbedded in it, and they present the rayed appearance of fish-scales. The skin includes, as a rule, many glands which are either simple and flask-shaped; and they assist, by their secretion, in the process of moulting, or they may be composed of a number of sac-like bodies, and in this case the secretion is often acrid and fœtid, and is fatal to small creatures; and, when not so, it is equally viscid, and lubricates the surface and makes it slimy. These complicated glands are collected at certain parts of the body, especially near the back of the jaw in the parotid region, in Toads and Salamanders, and also on the sides of the body and on the hind limbs. The colour of the skin and its shades are produced by colouring granules which are situated in the epidermal cells, and also by the presence of very large branched pigment cells in the skin, which, as in the Frogs, for instance, produce changes in colour by alterations in their shape and position. With regard to the bones of the skull and skeleton, it is remarkable and significant, that in these low Vertebrates they can be compared with and named from those of the higher animals. The bodies of the vertebræ are of bone, and there are intervertebral cartilages; there are also relics of the notochord, an embryonic condition of the vertebral column. The shape of the body of the vertebræ differs in the various groups. The sacrum rarely consists of more than one vertebra, but there are exceptions. With regard to the skull, the base and part of the sides are differently arranged to the corresponding regions in the Reptiles and higher Vertebrates, for the Amphibia have not complete basi-

occipital, basi-sphenoid, supra-occipital, ali-sphenoid bones, or pre-sphenoid cartilage bone; and a great membrane bone, the pre-sphenoid, covers the base of the skull instead, from the occipital to the ethmoid region, as in some Fishes. There are two pre-maxillæ, and the maxillæ are usually present. There are pterygoid bones, and, except in some Frogs, there are palate bones. With regard to the hinging of the lower jaw to the skull, there is a membrane bone called temporo-mastoid, which extends from the side walls of the skull to the articular head of the lower jaw, which has a dentary, splenial, and usually an angular bone entering into its composition. There are no sternal ribs. The heart has but one ventricle, two auricles, and a long swelling to the main artery, which has contractile muscular fibres, and sometimes valves and longitudinal partitions in it called the arterial bulb (*bulbus arteriosus*). But besides these there is a space bounded by contractile walls, into which the venous blood from the body pours, before it enters the right auricle. The left auricle is usually smaller than the right, and a single pulmonary vein from the lungs enters into it. The interior of the ventricle is more like a sponge (Huxley) than a chamber with well-defined walls. The bulbus arteriosus springs from it, and ends on each side in either three or four trunks, which ascend upon the branchial arches. The variation in the number of these main trunks, which resemble so many arches in the different groups of Amphibia, is considerable. In the adult and perfect Amphibia the circulation of the blood closely resembles that observed in the lowest or simplest amongst the Reptilia. In a general sense it may be stated that the little-left auricle receives the blood from the lungs, where it has been aërated and made to resemble bright arterial blood during the process of respiration, by means of the pulmonary veins. At the same time the larger right auricle receives the dark impure blood from the great veins (*venæ cavæ*) of the body, head, and internal organs. The auricles thus diversely filled contract, and the pure and impure blood are forced into the single ventricle. The mixture is then partly expelled upwards into the muscular main artery to supply the body, and partly through a vessel into the lungs, to be re-aërated. The blood is cold, and the red blood-corpuscles are large.



HEART OF FROG.

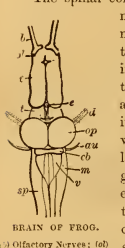
(a) Auricle; (c) Ventricle; (ao) Aortic Bulb; (1, 2, 3) the Aortic Trunks; (cg) Carotid gland; (l) Lingual Artery; (c) Cœtid Artery; (pc) Pulmo-Cutaneous Artery; (p) Pulmonary Artery, with ramifications over Lungs.

The termination of the main artery into three or four arched trunks on either side relates to the method of respiration of the Amphibia. In some there are lungs within the body, the Frog being the common example; and in others there are external gills, or branchiæ, which last during the whole life of the animal, and the Siren is a well-known type. It is evident that a different distribution of the blood-vessels must occur in them. Moreover, in the Frog and others, like the Tritons, the young immature creature has gills and leads a fish-like life, but the adult has lungs only, so that a very considerable change in the organs of the circulation must occur in them during early life. Again, the gills are external in some, but in others they become internal, and the leaf-like gill seen outside is replaced by internal ones, which are supported by arched bony or gristly processes connected with the hyoid bone of the throat, and to which the water gains entry through clefts in the side of the neck. Each external gill and each of the internal kind supported on an arch of the hyoid bone, requires a branch of the main artery. When the branchiæ are in full action in the Tadpole, and the lungs are still rudimentary, the tympanic bone is greatly enlarged, and it forms the base on which the branchial apparatus is suspended by means of a thick angular portion. Between these angular portions and the median bone is a single piece, and two rhomboidal masses, to which are suspended the arches on which the branchiæ are supported, are attached to it behind, one on each side.

During growth the mandible, or lower jaw, increases in size, the tympanic bone relatively diminishes, the angular portions elongate, and a process of each, cartilaginous in its texture, is attached to the cranium. As the lung is developed and the branchiæ are absorbed, the separate parts of the apparatus behind the jaw are gradually fused in one, and the arches are lost.

In their nervous system the Amphibia are intermediate between the Reptiles and Fish; and if

the brain and spinal cord of the Frog be taken as the type of the higher group, it may be said that the first is small. The front of the brain, or the region where the olfactory nerves arise, is a rounded swelling, and behind it are feebly-developed and rounded-off cerebral hemispheres, which contain cavities or ventricles. Behind is a space, in which is the pineal gland and the region of the optic thalami, and the optic lobes are distinct and in front of a band-like cerebellum. The medulla oblongata has a ventricle in it.



BRAIN OF FROG.

(b) Olfactory Nerves; (d) Olfactory Swelling; (c) Cerebral Hemispheres; (t) Optic Thalami; (op) Optic Lobes; (e) Pineal Gland; (d) Origin of Optic Nerves; (au) Auditory Nerves; (cb) Cerebellum; (v) Position of Fourth Ventricle; (m) Medulla Oblongata; (sp) Spinal Cord.

The spinal cord is long in some of the Amphibia, but it is not so in the Frog. The cranial nerves are small as a rule, as there is little expression in the Amphibia and the nerves of special sense are not highly developed. The eyes always exist, although they may be hidden beneath the skin, and they are very small in some kinds which inhabit subterranean waters or burrow in the earth. In those Amphibia in which the gills, or branchiæ, last through life or are perennial (*Perennibranchiata*), there are no eyelids, but they are found in some of the others. Nictitating membranes exist in some, and the Frogs and Toads have a special muscle which drags the eye farther within the orbit. All have simple organs of hearing, and in most there is a labyrinth and three semicircular canals, and there is a *fenestra ovalis*, and a gristly or cartilaginous auditory ossicle — the *columella*, or *stapes*, whose expanded end is fixed to the membrane of the *fenestra*. The worm-like kinds, the tailed Amphibia, and one group of the Batrachia (*Pelobatidæ*), have no tympanic cavity or membrane; but in other Batrachia they exist, and the outer end of the *stapes* is connected with the tympanic membrane, there being cavities opening into the throat also. The sound vibrations of the air or water are therefore conducted from the outer tympanic membrane, through the single *stapes* (not through three bones, as in the higher animals) to the internal ear.

In the adults of the Amphibia, the whole alimentary canal is of a very simple character. The œsophagus is wide and short; the stomach is single, and consists of a simple sac, which is globular in the land kinds, and is longer in the aquatic. The intestine is but slightly convoluted, and the large and small parts do not differ much in size. The liver, gall-bladder, pancreas, and spleen exist in all the Amphibia. A urinary bladder exists which opens into the vent, and the kidneys resemble those of fish more than those of higher Vertebrata, being persistent "Wolffian bodies" rather than true kidneys. These "bodies" are found with the kidneys in the young unborn Mammalia, but they are of no use after birth, and the kidneys act alone. They persist in the Amphibia and Fishes.

In the adult Frog, Toad, Salamander, and many others, the air is taken in by the lungs, not by the expansion of the chest by ribs and the consequent inrush of air to fill the space, as in the higher animals, but by a swallowing process resembling that of the Tortoise (p. 248). The inflation of the internal bag of the lung is produced by the creature first of all depressing its tongue and the hyoid bone, and thus enlarging the cavity of the mouth, so that air rushes into it through the nostrils, the mouth being shut. Then muscular contraction is exercised on the cavity and on the hyoid bone, so that the air is forced through the air-tubes into the lungs. The escape of air back again, by the nostrils, is prevented by their edges acting as a valve, and also by the tongue being pressed against them when it exists; and its entry by mistake into the œsophagus and stomach is prevented by closure of the gullet spasmodically. Hence the way to suffocate a Frog is to place something in its mouth which will keep the jaws apart, so that the air escapes and does not go into the lungs. The primary necessity for this Tortoise-like breathing is from the absence of perfect and sternal ribs.

In the case of the Amphibia with branchiæ, or gills, the water, in passing over them, carries air with it, and the oxygen in it is devoted to purifying the blood. But although these two kinds of respiration are explicable, there is a difficulty in explaining the use of the rudimentary lungs in those Amphibia which never shed their branchiæ, such as the Siren and the Proteus. The construction of their nostrils resembles those of fish, and the lungs are thin and extremely delicate; moreover, they are contracted near the gullet. Indeed, it does not appear that when the Siren is dying from having impure water acting on its branchiæ, that the lungs assist in the least in respiration. Bell long since considered these bag-like "lungs" to be similar organs to certain air-bags in fish, which will be

explained in treating of that group, and which have been considered to foreshadow the lungs of the higher animals.

The existing Amphibia are classified in three great groups or orders. In one there is no tail present in the perfect animal, although it is present in the tadpole or immature state. These are called the ANOURA, or Tailless Batrachia, and they are the Frogs and Toads.

The next group contains the Amphibiæ, which have tails throughout their whole life. These are the URODELA, and they are subdivided into those which have either the branchiæ (or gills), or else gill-clefts, external throughout life—the Ichthyoidea; and into those which have neither branchiæ nor gill-clefts in adult age—the Salamandrinæ. The third order is that of the legless Amphibia, which are called APODA. The Salamandrinæ have the vertebræ concave behind, and eyelids, and the other group of the Urodela has biconcave vertebræ and no eyelids.

THE ORDER ANOURA.—THE FROGS AND TOADS.—THE TAILLESS BATRACHIANS.

The Tailless Batrachians, or the Batrachians proper, or the Frogs and Toads, have a broad head, largest behind, and a broad short body in the perfect state, and four legs, the hinder pair being the stronger, and longer than the others, and specially suited for leaping, swimming, or burrowing. Some climb, and then usually there is not a web between their fore toes, the extremities of which, and of the hind ones also, are dilated into round discs. But the degree of the development of the web of the fore and hind extremities refers to the power of swimming. Hence, it is not always found, and its size varies. Almost all undergo a visible metamorphosis, that is to say, they have a tadpole condition in water, and change to an adult, terrestrial, and different form.

They are found in damp places, or in the neighbourhood of water, and those living in temperate climates hibernate during the winter by getting down cracks into earth, or in the mud on the floor of ponds; whilst those living in the tropics, remote from water, bury themselves deep enough in the ground to escape the hot dry atmosphere. In both cases a lethargic condition prevails, until a change of season.

Their lungs consist of two large sacs, which may be expanded until the animal attains nearly twice its usual size. When they dive, the lungs are emptied of air, and the respiration will cease for a couple of hours, after which time a rise to the surface, to take in air, is requisite. But during the summer and winter state of existence the respiration is suspended at the same time that all the other functions —circulation and digestion, for instance—are very low, or cease.

Many males are provided with one or two membranous throat or mouth sacs, and when there are two, one is placed on each side of the mandible; and if there is but one, it is found between its branches. In either case the sac opens into the cavity of the mouth, by two slits, and is filled with air from the lungs. These sacs enable, by their contraction, a more or less loud noise to be produced. The males are often distinguished by a rough swelling on their thumbs, or by short conical spurs there, and, as a rule, they are more slender than the females.

There is usually a mass of glands, called the parotids, above the tympanum on each side of the neck. The skin of the body and limbs is not covered with scales or plates, and is naked and coloured.

The food consists of insects, slugs, and worms, and some very large kinds snap up small vertebrata. They seize their prey with their tongue, and draw the victim into the mouth as this organ is retracted.

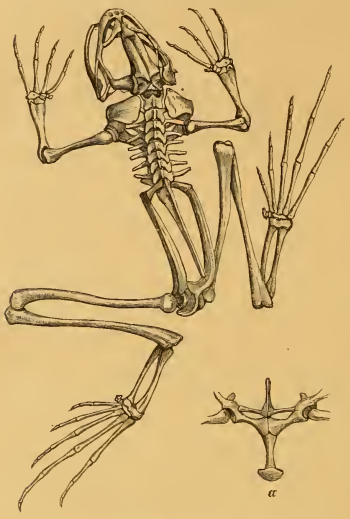
Teeth are not found in the lower jaw, and only a few have a pair of tooth-like prominences near the chin. On the other hand, the upper jaw and vomer are very frequently armed with a series of simple teeth, which in the largest species assist in capturing food. There is no mastication possible, and the prey is swallowed entire.

On leaving the egg, the larval or tadpole state commences, and the creature has external gills for a short time; then the gills become internal, and this immature condition lasts about 100 days, and during that time the internal anatomy and physiology greatly resemble those of fish.

They eat during the tadpole state, living on decaying water-plants and decomposing animal matter, and as they breathe by gills, they have, when young, three, and usually four, gristly or more or less bony gill supports, called branchial arches.

The bodies of the vertebræ in most of the adults are concave in front and rounded behind (procœlous), with the exception of the eighth, or pre-sacral, which is amphicœlous, and the ninth, or sacral, which has commonly one convexity in front and two behind. The vertebræ in front of the sacrum are never more than nine, and the tail part is in the form of a bony style, with two rounded arches.

The vertebræ are opisthocœlous, or hollow behind, in the genera Pipa and Bombinator; and in these, as in all other Amphibia, the bodies and inter-vertebral substances contain more or less distinct remains of the notochord. A sacral vertebra always exists, and its transverse process, and those of the vertebræ in front and behind, with which it is anchylosed, are large and usually expanded.



SKELETON OF A FROG.
(a) Sternum, &c.

The shoulder-girdle consists of, in the Frog, for instance, the shoulder-blade (in two movable pieces), the collar-bone, and the coracoid bone, and all these combine to form the joint cavity for the humerus. The collar-bone is connected with its fellow of the other side at the median line of the body, and the broader and larger coracoid meets its fellow also. The sternum consists of several pieces which extend from the front, anterior to the collar bones, to well behind the coracoids, where it ends in a broad cartilage. The front part is formed by the episternum. There are no ribs.

As the fore limbs are not of the importance of the hinder, the humerus is small, short, thick, and has almost a globular surface for the articulation of the bones of the fore arm. These are united in one. The wrist bones are six in number, and support four metacarpal bones, and the index and middle fingers have two phalanges each, and the others three. The thumb is small and rudimentary.

The bones of the well-developed pelvis present considerable differences in the various genera. Thus, in the Frogs (*Rana*), and the Tree Frogs (*Hyla*), the iliac bones are very long, and are movable on the sacrum; and they are very close together below, towards the joints for the long thigh bones, so that the two heads of these bones seem to be placed in contact. This peculiar arrangement influences the action of the hind limbs upon the trunk in the exertion of swimming and leaping. In the Pipa, or Surinam Toad, the iliac bones are very much widened at the point of junction with the sacrum, to which they are fixed, and which is itself dilated. The bones of the leg (*tibia* and *fibula*) are, in the Reptiles, generally distinct; but in the Frogs and their allies they are so soldered together as to form but a single articulation with the femur and tarsus, and to present the appearance of a single, very much elongated, bone. The knee-joint and articulating bones are so disposed that the feet have always a direction outwards.

The united leg bones are longer than the femur, and are followed by very long astragalus and calcaneum bones. Four small ankle bones exist, and the metatarsal bones and phalanges are very long, as they have to support the web when it exists, and to assist in swimming and jumping. The inner toe is well developed, and the fourth is the longest.

It is remarkable that the muscles of the abdomen should be more developed in these Anoura than

in the Reptiles, and that they should present, in this particular, some analogy to the abdominal structure of the Mammalia. But it is in the disposition of the muscles of the thigh and leg in the Batrachia that the greatest singularity is manifested. These, whether taken conjointly or singly, present the greatest analogy with the muscular arrangement of the same parts in man. There is a rounded, elongated, conical thigh, the knee extending itself in the same direction with the thigh bone, and a well-fashioned calf to the leg.

The locomotion of the Batrachians on the land consists in walking, running, and leaping, the last being the most prevalent motion. The greater part of them are excellent swimmers; and when they betake themselves to this exercise the body is extended horizontally, and the animal is propelled by the mechanism of the lower extremities alone. It is impossible to watch the horizontal motions of a Frog in the water, as it is impelled by these muscles and its webbed feet, without being struck with the great resemblance, in this position, of its frame to human conformation, and the almost perfect identity of the movements of its lower extremities with those of a man making the same efforts in the same situation. By the aid of these well-developed lower limbs, and the prodigious power of their muscular and bony levers, some Frogs can raise themselves in the air to twenty times their own height, and traverse, at a single bound, a space more than fifty times the length of their own bodies.

The tongue performs a leading part in the capture and deglutition of the prey. It is very soft and fleshy, and is not supported at its base by an os hyoides, as in the other Vertebrata, but it is fixed in the concavity which is formed by the approach of the two branches of the lower jaw towards the chin. In a state of repose, and when the mouth is shut, this tongue, which has its root, so to speak, in front, has its free extremity or tip in the back part of the mouth, and before the aperture of the air-passages; but when the animal puts it out, the lower surface comes upwards and the tip reaches far beyond the mouth. The tongue is armed with a tenacious, viscous secretion, and when it touches the prey this adheres so firmly to it, that it is carried back with the tongue into the mouth. All this is done with a rapidity which the eye can hardly follow. The noises, produced by the expulsion of air, vary from the well-known croaking of the Common Frog to the bellowing of the Bull Frog, and the shrill trebles of the males of the species of the Tree Frog. They, and the flute-like and metallic sounds occasionally given out, and the sort of seemingly ventriloquial grumbling which some species of Toads exert, are vocal sounds emitted above the larynx, from the mouth, or from some of the membranous sacs.

HEAD OF FROG (*Phyllomedusa*), SHOWING TONGUE FIXED IN FRONT BUT FREE BEHIND.

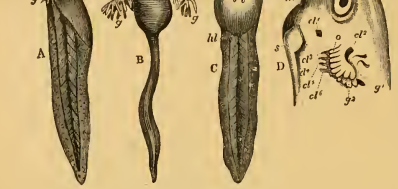
The croakings, produced by the throat bags, seem intended to make the one sex sensible of the presence of the other. Thus the Green Frog has two cheek-pouches, which are inflated by the animal in the breeding season by means of two apertures close to the end of the great air-tube of the throat; and the folds of the larynx, called chordæ vocales, are very large and distinct in many species. The glottis bears, apparently, considerable analogy to the upper larynx in birds.

The naked skin of the Frogs, and, indeed, of the Batrachians generally, has the power of acting in such a way as to fulfil in a great degree the functions of the lungs, and aërated water may be made subservient to this cutaneous respiration. This has been proved by experiments made on Frogs which have been kept in vessels, and under water charged with air, renewed from time to time, and on Toads which have been kept alive for months in nets sunk under running water, at a low temperature, without any direct access to atmospheric air.

The spawn seen in water in the spring time is a mass of semi-transparent, gelatinous, round bodies, with little dark-coloured specks inside each. From these are developed the larvæ, or Tadpoles.

Commencing like aquatic animals, the larvæ of the Frog, and other Tadpoles, exist very much after the fashion of fishes, moving and breathing like them, and resembling them in shape, on account of the long flat tail. As time elapses, under the influence of warmth and food, the growth does not take place in a manner which will simply enlarge the animal, but it produces alterations in the outside form,

in the method and structure of respiration and circulation, and also in the organs of motion, special sense, and digestion. So that during the earlier lifetime, an incomplete and altogether differently-shaped creature is being perfected into a permanent adult form. This process is called metamorphosis. In the early days of Tadpole life much of the organisation (circulation and respiration) is very like that of the fish, for the simple heart of these last is furnished to the little things. There are minute thread-like gill-fringes, or branchiæ, just behind the head, and they only require a heart which will supply them — a single or branchial heart. But as growth proceeds, the branchiæ become hidden in a cavity, and then are absorbed, the lungs growing within, and a heart which has a double nature, and which relates to the body and also to the lungs, being systemic and pulmonic, is gradually developed. The limbs are at first scarcely perceptible, and become gradually developed, passing through a rudimentary stage beneath the skin, from which they do not emerge until they have attained considerable size and a definite shape. The hind legs appear first, and they are soon employed to assist in a feeble manner the strong and active tail in moving about. The tail is developed to a great degree, and it is made up of muscles surrounding vertebræ, which form a long column, but they are not ossified (in those Amphibia in which the tail persists the vertebræ are ossified early). As weeks pass on the limbs grow, and the tail diminishes by absorption, and gets smaller and smaller, until it disappears. It does not drop off, but its substance is received grain by grain into the adult animal. The skull, very cartilaginous at first, becomes consolidated and bony to a considerable extent, and thus is more reptilian than fish-like.



STRUCTURE OF THE TADPOLE.

(A) Side View, showing Gills, *g*; Mouth, *m*; Nasal Sac, *n*; Eye, *e*: Ear, *a*; (B) from below, *ss*, Suckers; *o*, Operculum; *f*, Horny Jaws; (C) More advanced Tadpole, showing growth of Operculum, so as to enclose Gills, save at opening *b* on left side; *hl*, rudiment of hind limbs; *s*, Sucker; (D) Head of young Tadpole (magnified): *gl*, *gz*, external Gills; *lp*, Upper Lip; *cl*¹ to *cl*⁶, Clefts.

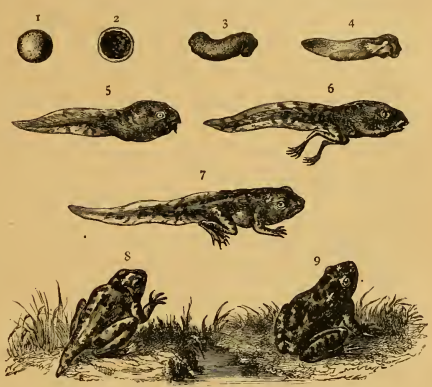
The branchiæ at first appear in about fifty hours, when the temperature is warm, as small projections, and shortly afterwards a "holder" appears on either side of the future mouth. Before the fourth day in hot places, and in England not for a month, it emerges, jerks itself about, and breaks out of the egg a free swimmer.

The branchiæ consist of two principal divisions, or branches, from each of which proceed four or five leaf-like processes subdivided into numerous little filiform leaflets regular in shape, and forming the ultimate divisions of the structure. On these ramify the minute capillary blood-vessels, and the blood undergoes its change there, being oxygenated, and evolves carbonic acid gas. A minute branch of an artery conveys the impure blood from the heart and enters each leaflet at its base, and passes along its shorter or inner margin, giving off capillary branches in its course, which, after meandering over the surface of the leaflets, and communicating with each other in various directions, pass over to the opposite side, and join and form a branchial vein. This unites with others at the base of the leaflets, and thus a vessel is formed which takes the purified blood to the heart.

In this stage the circulation of the blood may be seen, under the microscope, to perfection in the gills. The current of the blood passes up each stem of the branch, and a distinct stream is given off to each leaf. It is propelled to the end, and returns down the opposite sides by the veins. Every blood corpuscle—red and white—is visible, and they move in the transparent vessels with singular regularity. As growth proceeds the branchiæ become fully developed, and then they begin to diminish in size, become obtuse, and are gradually so reduced as to be withdrawn within the branchial cavity, and concealed by a little cover, or operculum, of the integument. It must be noticed that as soon as the true Tadpole shape is assumed, and the branchiæ are within their cavity, and in communication with the outside through certain slits in the neck, they are supplied with water, which enters the

mouth by the nostrils which are supplied with valves. When in the mouth, which is closed on all sides, with the exception of the throat, where are the gill or branchial slits, the water, acted upon by the muscles which cover them, traverses their spaces, and bathes the branchiæ, before its exit through the slits.

The eyes are perfectly formed at this time, and the mouth has changed its position from below to the extremity of the head. It is very small, and there are no teeth, but minute horny plates are on the jaws, sufficiently strong to tear the soft animal and vegetable substances which form the food. The Tadpole has a digestive system, the stomach being succeeded by an intestine which is of nearly equal size throughout its length, which is great. It is at least ten times as long as the inside of the body, and is curled up in a coil, and it occupies most of the abdominal cavity. During the growth of the Tadpole, and its change into the perfect Frog or Toad, it becomes shorter in proportion to the length of the animal, until at last it is not one-quarter of its original length.



METAMORPHOSES OF FROG.

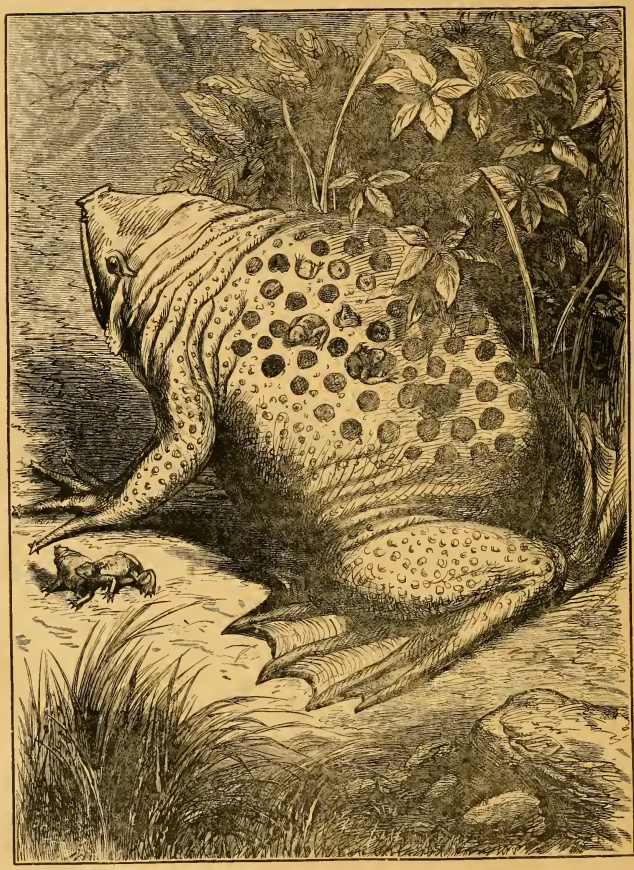
(1) Egg of Frog; (2) Egg Fecundated, and surrounded by its Vesicle; (3) First state of Tadpole; (4) Appearance of Breathing Gills; (5) Stage with Internal Gill-; (6) Formation of Hind Feet; (7) Formation of Fore Feet and Decay of Gills; (8) Development of Lungs and Reduction of Tail; (9) Perfect Frog.

The tail soon becomes developed sufficiently to move, and to move its possessor, and the colour of the body changes, becoming a soft olive-green instead of black, the abdomen being dotted with golden-yellow. The external form thus altered remains for some time, and the rudiments of the hind limbs appear, the toes budding at their extremities. Soon the fore limbs do the same. Then, as the hinder limbs increase, the tail is removed by absorption, which begins at the tip. When the branchiæ have ceased their function, and lungs have developed, the creature is tail-less, and having long hind legs, comes to land, for it has become capable of respiring air with its lungs, and of hopping and jumping to search after small insects and worms. As growth proceeds, the webs to the digits, barely visible at first, become important structures, and the colour, glands, and ornamentation of the skin are noticed. Such multitudes, writes Bell, have been found in damp weather as to have given rise to many a story of its having rained Frogs. They now grow rapidly, until the approach of winter causes them to seek a retreat for hibernation. Bell states that so numerous are the enemies of the Tadpoles and young Frogs in the form of birds, fish, reptiles, and the smaller carnivora, that not one in a thousand survives. It is some time before the adult condition is reached, for Batrachia grow for several years, and then may be said to be perfect.

THE AGLOSSA (THE BATRACHIANS WITHOUT TONGUES).

The first sub-order of the Anoura contains those which have not a tongue. They are large, flat, ugly creatures with the eyes placed far forwards and close to the sides of the mouth, and their tympanum is concealed. All have the hind feet with a perfect web between the toes, and they live in hot countries, having a remarkable geographical distribution. There are three families of them.

The Surinam Toad, which was first noticed by Sibylla von Merian, in 1708, and which is a flat toad-like creature with a short, broad, and pointed head, huge hind limbs with webbed



SURINAM TOAD. (*Pipa americana.*)

feet, and small fore limbs with four slender webless fingers curiously ending in four small projections, sometimes grows to a length of nearly a foot. It has a blackish-brown body, and is a native of Surinam and of the neighbouring parts of South America. Living a monotonous life, apparently on land at the edges of the swamps and plantation ditches, and amongst buildings, this *Pipa americana*,

the representative of the family of Pipidæ, has neither tongue nor teeth on the jaws and palate. Besides being huge and curiously made, it is very remarkable, for there is a portion of its life-history which is very extraordinary. The back of the female is covered with soft skin, which overlies a great lymphatic space, and in the breeding-season it develops cavities and ridges, and each of these separate compartments contains a young Pipa undergoing its metamorphosis. It is very evident that each of these cavities, which give the back a honeycombed appearance, has contained an egg, and the question is how did the egg get into this extraordinary position. Certainly it would not be deposited there by the mother, and equally certainly there is no passage from the egg-producing structures in her body to the cavities. It is said that as soon as the female lays her spawn the male places it in the cavities in the back of the female, and the eggs form little pits by their pressure on the skin. Probably this takes place in the water. Firmin states that the female lays her eggs in sand, and that the male clasps them between his hind feet, and then jumps on to the mother and disperses them over her back. She then goes into the water, and the eggs are hatched there, and the tadpole state is passed through in the cavities, so that in eighty-two days sixty or seventy young ones poke out their heads and limbs and jump off as perfect Pipas, the mother having returned to land. Then the female retires to a stony or reedy retreat in water, and changes the skin of her back. How much of this is true is not quite known.

The second family, the Dactylethridæ, has a species in Africa, but it is more Frog- than Toad-like in shape. The upper jaws and intermaxillaries have teeth, and the three inner toes of the long feet have claws. The species is *Dactylethra capensis*.

Australia contains the other family, the Myobatrachidæ, and in the species *Myobatrachus paradoxus* there are two large teeth in the intermaxillary bones, and the passages from the ear to the throat, or the Eustachian tubes, enter the gullet separately, and do not form a common canal, as in the other families. Very little is known about their habits.

THE BATRACHIANS WITH TONGUES.

The second division, or sub-order, the Phaneroglossa, are the Anoura with tongues, and there are two groups of them—the Oxydactyla, which have pointed tips to their digits and toes, and the Discodactyla, which have discs to them ; and these are divided into families.

THE OXYDACTYLA.—FAMILY RANIDÆ.

The True Frogs, the *Ranidæ*, form the first family, and they have a slender and longish body, very long hind feet and limbs, with the long hinder toes united by a web. The upper jaw, intermaxillaries, and vomer have small curved teeth, which are rarely seen on the mandible. The skin is smooth and the tympanum is visible, and the pupil of the eye is round or transverse. The Common Frog,* the type of the family, is of a greenish-brown, yellowish, or reddish colour, with an oblong brown spot behind the eyes, and the legs have brown cross-bars. It is, as is well known, found in almost all parts of Great Britain, wherever there is a river or pond, or even sufficient shade to maintain the degree of moisture necessary to preserve the skin in a condition in which it may assist in the respiration of the animal. They have been in Ireland since the beginning of the eighteenth century, and probably they were artificially introduced, and became acclimatised. The Frog feeds sometimes with eagerness, and captures with its rapid tongue many kinds of insects, beetles, and slugs, and is an excellent friend to the gardener. They assemble together in the spring, when they croak in chorus, and the sound has often a very peculiar effect on a still evening; and as cold weather comes on they sink themselves in the mud under the water, and Bell says often in multitudes, which are found embracing each other in a torpid state. In the spring they come forth, and the egg-laying soon begins, and the Tadpole, whose life has already been noticed, turns in due time to a creature like its parent. The deposit of eggs takes place at the bottom of the water, and the mother cares nothing about them in future. She and the male are surrounded by a host of enemies, and snakes, birds, small animals, and fish, are constantly looking out for them. The male is smaller than the female, and the extreme length is about two inches and three lines from the snout to the hinder

* *Rana temporaria*.

extremity. On the whole, the Common Frog is not an extreme frequenter of water, except during the egg-laying season.

Bell tells a story of a domesticated Frog, who came at meal-time, and snugged up to the cat in cold weather; but it must have been an exceptional Frog. Usually they can be made not to fear their kind feeder, but the rising generation tease them and enjoy their prodigious jumps. Fishermen use them as bait for pike, and physiologists show the circulation of the blood in the web of the foot, and Matteuchi discovered a special galvanic energy in batteries made up of their thighs, so that on the whole, the Common Frog has little to thank humanity for. Bell stated that a large Rana had been found in Scotland, but was doubtful whether it was a variety of the Common Frog or a new species. The web of the foot forms a beautiful microscopic object, and the circulation of the large oval blood corpuscles, and the white or colourless corpuscles, can be seen in it. The species and its varieties have a great geographical distribution.

The development of the Tadpole into the Frog has been already described, and it is merely necessary to observe that the masses of eggs, or spawn, when first expelled, consist of numerous small opaque globular bodies covered with a glairy substance. This absorbs a large quantity of water, and soon increases in diameter; so that the black specks, the future Tadpoles, are separated by the glairy envelope one from another. The development of the young is more or less rapid, according to the temperature. The embryo is at first a small spherical body, one side being dark brown and the other paler. A furrow grows across the dark half, dividing it into two equal parts, and this is soon afterwards crossed by another at right angles. A third and fourth furrow are produced and so on, until the sphere is separated into as many granules. In the course of the

COMMON FROG.

second day the sphere begins to elongate, and a groove, which had previously divided the upper part into two, begins to close up, and the head becomes prominent, the tail begins to show itself, and the little hooks, by which it subsequently lays hold of things, begin to appear. In somewhat more than fifty hours the head becomes well marked, the membrane of the tail is seen, and the first indications of branchiæ occur on each side of the head. Moreover, the muscles of the spine may be seen. The whole creature grows, and these parts become more distinct, and the branchiæ consist of two tubercles on each side, and as yet are undivided. The young creature now will give some signs of voluntary movement, and the nostrils are seen, but the mouth is scarcely observable. The eyes are just visible. The next stage is a division of the branchiæ into lobes, and the blood may be seen circulating in them. The embryo is still restricted to a curved position by the substance round it, and it may be seen to jerk itself about until it escapes. Bell says that although all this may be done in the warm waters of the South of Europe, or in artificial water at a temperature of 73°·4 Fahr. in four days, it takes at least a month in a colder climate. The rest of the metamorphosis has been described in explaining the general peculiarities of the Amphibia (p. 348). When the metamorphosis is completed, and the little Frog has received its permanent shape, the skin gradually becomes coloured, and, according to the light, the prevailing colours of the surrounding objects, the health of the creature, and possibly from nervous influences, the tints change, the mobility of the colour corpuscles within the skin being the cause. It appears that the skin of the Frog, when kept damp, plays an important part in the elimination of carbonic acid gas, and also in the absorption of oxygen from water, and probably from air; for experiments have shown that the lungs are not sufficient to carry out the respiratory process perfectly, so that the skin must be utilised. Bell believes that during the damp condition of the skin water is absorbed and stored in a sac which acts as if it were a urinary bladder. This store he considers is kept to moisten the skin when it requires it for the purpose of respiration. It is re-absorbed and deposited in the skin.

In vertebrate animals the bones may be formed with a groundwork of cartilage, in which osseous grains are gradually deposited, and such are cartilage bones. Others have no cartilage, but the bone is deposited in a membranous tissue, and such are membrane bones, of which the parietal or frontal bones of the mammalia are examples. Huxley states that in the higher vertebrates the cartilage bones rarely remain as such, but the ossified cartilage becomes absorbed and is replaced by a membrane bone derived from the investing tissue.

The Frog's skull is characterised by a cartilage bone called by Cuvier the os en ceinture, or girdle-bone. "It is an ossification which invades the whole circumference of the cranium in the pre-sphenoidal and ethmoidal regions, and eventually assumes somewhat the form of a dice-box, with one-half of its cavity divided by a longitudinal partition. The septum and the front and back halves of the bone correspond to the ethmoid pre-frontals, and the orbito-sphenoids of the other vertebrata." (Huxley.)

The Edible Frog,* found and used as an article of food in many parts of the Continent, is also an inhabitant of England. It can be readily distinguished by the absence of the large distinct black mark on the side of the head to the shoulder, seen in the Common Frog, and by the presence of a light-coloured line running down the back, and by its marking with round circumscribed spots. The thumb has two large tubercles on it in the male, whose vocal sacs are large and globular. Mr. Bond found them in Foulmere Fen, Cambridgeshire, and observed that their croaking was different from that of the Common Frog, the sound being like a loud snore. It is a timid animal, disappearing on the least alarm, seems to come rarely, if ever, to land, and is essentially a dweller in the water. It inhabits running or still waters, rivers, streams, lakes, ponds, salt or fresh marshes, and even ditches, and it may be seen sunning itself on a water-lily leaf, and rarely on the banks. The slightest noise alarms them, and they rush to the water. Their remarkable croak has procured them the title of Cambridge Nightingales. When this is going on the male blows out his sacs, which appear on each side of the head. This description holds good for the Continental Esculent Frogs. The hind legs are the parts which are to be cooked, and in spite of some folk's antipathy, there is no doubt that they are very nice when well cooked and served, for they taste like the most delicate spring chicken.

The genus Rana is well developed in America, and the American Bull Frog is well known (*Rana*

* *Rana esculenta.*

pipiens vel mugiens). It has a large head, green above and yellowish-white below. The body is large, green in front, dusky-olive behind, and has irregular black blotches. The under parts are yellowish-white, and the limbs are dusky, with black bars. The iris is of a beautiful golden colour with black marks, and the tympanum is large and is bronzed. It reaches from thirteen to twenty-one inches in

EDIBLE FROG.

length, limbs included. They are very active and leap to a great distance, and yet it is a very aquatic Frog, and they will live in the water for years. Sluggish rivers and stagnant ponds are their delight, and except in the breeding season, they are solitary. Then they collect in hundreds, and their croak is very loud, and they may be heard half a mile off. When taking the water they skim along the surface at first. Insects, small crustacea, and snails are their food, and they are found in every part of the United States, and as far north as Quebec.

There are none of these True Frogs in Australia, or in the Islands of the Pacific.

Amongst the not very numerous East Indian species of the genus Rana is Kuhl's Frog,* with a large web to its feet. It lives in Ceylon, Java, Celebes, and in China. The lower jaw has a pair of fang-like prominences in front. The Indian Bull Frog † has the web broad, notched, and it does not extend to the extremity of the fourth toe. It is common over the whole of Hindostan, and is found also in Ceylon, Sikkim, the Malayan Peninsula, China, and the Islands of the Archipelago. Some measure six or seven inches in length. The young are very small. They abound, and when they are frightened they jump over the surface of the water much in the same manner as they do on land. Dr. Günther has described the Edible Frog ‡ from Ningpo, and thus its distribution is not only in every part of Europe and in North Africa, but also in Central Asia to China and Japan. A Frog closely

CYSTIGNATHUS ORNATUS.

resembling the English *Rana temporaria*, but having larger limbs, is found in Japan and in the neighbourhood of Ningpo; and it is even allied in shape to *Rana silvatica* of Lecomte, from North America.

With regard to the African Frogs, there are two sharp-headed, slender-bodied, long-limbed, beautifully-marked Frogs, which have been described from South Africa by Dr. A. Smith. One, Delalande's Frog, is common everywhere, and especially near Cape Town. It is generally observed on dry ground, but readily takes to water when alarmed or pursued. The other inhabits Kaffir Land and Port Natal, and is about four inches and three-quarters long, and is called *Rana oxyrhynchus*. A sprawling, long-legged, stupid Frog is *Rana fasciata;* it has great toes and long legs, and is about one inch and a half long. It is widely spread over South Africa, inhabits damp localities, leaps freely and for considerable distances.

One Frog is fished for, with fish-hooks baited with flesh, in Southern Africa, and it is common near Cape Town. It is *Rana fuscigula*.

The Frogs of the genus Pyxicephalus are found in South Africa and India. All have the fingers quite free, the toes incompletely webbed, and the head thick, rounded, and swollen behind. The vomerine teeth are in two oblique series, and the tongue is large, free, and deeply notched behind. The metatarsus has a flat, sharp-edged shovel-like prominence. One species is found in Hindostan and in the Himalayas, and with the aid of its shovel-like metatarsal it burrows in the ground to a depth of one foot and a half.

One of these is called the Bull Frog, in South Africa, from the strength and hoarseness of the sounds it emits, particularly during the night. It lives generally in water, and is only seen in it

* *Rana kuhlii.* † *Rana tigrina.* ‡ *Rana esculenta.*

HORNED CERATOPHRYS.

or in its vicinity. Dr. Andrew Smith saw many in water, where at other seasons none existed, and the probabilities are that they bury themselves during the dry season. They are beautiful Frogs, five inches and a half in length, and their green, brown, and red tints, and pretty eyes, make them very picturesque.

Some species of the family of the True Frogs have no teeth on the vomer, and they belong to the genus Oxyglossus. A species lives in Java, and some fossil kinds, which are found in the so-called Frog-beds of Bombay, are of an early Tertiary age.

The Jakie* is a greenish Frog spotted with brown, and has irregular linear markings of a brown tint along its thighs and legs. It is from Guiana, and is said to have the largest Tadpole of all the Frogs. So large, relatively, is this larval form, that when the tail is absorbed no increase of growth in the adult occurs.

A large Frog, with the upper eyelids ending in a kind of triangular horn, from each of which a ridge runs down the sides and back to above the hinder extremity, is sometimes thirty-five lines long. It belongs to the genus Ceratophrys.† It is a Brazilian kind, and little is known about its life. Mimetic, as it were, of this curious Frog is a genus whose species have also the upper eyelids prolonged, and which have a broad and short body. The skull is marked with long ridges; there are folds of skin on the neck, and the limbs are of moderate length, the toes being distinctly but shortly webbed. The iris is a golden-brown, and the pupil is vertically rhomboidal. The body is much blotched with white and black, and there are two species. One has a prominence on the skull,‡ and lives in Borneo, Malacca, and Sumatra, and the other, without the structure,§ is restricted to Java and Ceylon. They have the tympanum hidden, and really belong to a small sub-family, of which the Painted Discoglossus of the countries bordering on the Mediterranean is the type. They have the tongue almost circular in outline.

A beautiful little Frog with a body about one inch and a quarter long, having a small head and a short and thick body, is of a dove-colour above, and is exquisitely marked with oblong spots and bars of dark brown margined with yellow. It has a small mouth, and the palate is armed with two groups of exceedingly minute teeth between the posterior nostrils. It has pretty eyes, and the lower surface is silvery white. It is a South Carolina Frog, and takes to the dry cornfields, and appears to like land, and, indeed, Holbrook states that one thrown into the water did not know how to swim. It has not the web on the hind feet, and in this it resembles some South American and West Indian species, nor has it parotid glands. They all belong to the genus Cystignathus. It forms a sub-family.

The second family of the Oxydactyles is called the PELOBATID.E, and it contains some kinds which are to a certain extent intermediate between the Frogs and Toads. They have the skin more or less warty or glandular. The body is plump and squat, but the upper jaw has teeth. Usually the membrane of the tympanum and its cavity is deficient, and the pupil is often vertical. They lay their eggs in strings like the Toads, and most of them are terrestrial, and make holes and burrows in the earth, only seeking the water during the egg-laying season.

MALE OBSTETRIC FROG.

The first example‖ is one which has a distinct tympanum and a small parotid gland, but it has no vocal sac. It has short limbs and large glands around the ears. The toes have half webs, and it is grey in colour with spots. It is remarkable for boring long burrows, and for the curious practice of the male, which has a very sonorous voice, of assisting the female to get rid of her eggs. These are large and in strings, and he attaches them to his thighs with a glutinous secretion. He buries himself until the eyes of the little Tadpoles can be seen beneath their envelope, and shortly afterwards he seeks a stagnant pool and plunges in. The Tadpoles soon burst forth and swim away. It is a small Frog, and is to be found in the environs of Paris.

Another kind has webs to its hind feet. The tympanum and its cavity are deficient, and the tongue

* *Pseudis paradoxa.* † *Ceratophrys cornuta.* ‡ *Megalophrys nasuta.*
§ *Megalophrys montana.* ‖ *Alytes obstetricans.*

is fixed. It jumps and swims nearly as well as the True Frogs, and has a warty body with a dirty green tint above, and the belly fiery red and spotted with blue. It is called the Fire-bellied Toad, and has a fine sonorous voice, and the cry is *ouvk, ouvk.** The larvæ are large; it is a dweller in marshes, and is an European kind.

The genus Pelobates is the last of this family to be noticed, and it has species in France. They are fine Frogs, having the tongue free behind, but scarcely notched. They have no tympanum, and the arms have a special gland and the hind feet a sharp swelling. The web is complete in the feet.

FIRE-BELLIED FROG.

One is grey-brown in colour,† smells like onions, and jumps like a Frog, and makes holes and burrows in the mud with its hind limbs. It has a loud cry of *ouk*, and the metamorphosis of the very large Tadpoles lasts a long time.

The Globose Cacopus Frog is worthy of its name, and is found in the Madras Presidency. The head is very short, and so are the limbs, and the mouth is small; the body is bulged out in a globular form, and the limbs and toes are short and slightly webbed. It has a small eye with a round pupil, and the skin is smooth, brown, and black on the tail. They have a circular tongue. Dr. Günther states that he has seen two specimens of this species, one thirteen lines long, and a larger thirty-four lines long, which was a female. "The little one is distended with fluid in an extraordinary manner, so that the body has the shape of a ball, from which the head and limbs project. The fluid is contained in the abdominal cavity. The larger individual is distended in a similar way, but this is caused by an extraordinary development of the ovaria (or egg-producing structures). These organs become so large that, not having room in the cavity of the body, they extend right across the back, so that the animal is completely surrounded by a mass of the ovaries."

The Common Toad ‡ is, of course, the type of the third family, the BUFONIDÆ. It has a swollen, heavy-looking body, covered with a warty skin, and it has a large flat head with a rounded blunt muzzle. There is a swelling above the eyes studded with pores, and the parotids are large, thick, prominent, and secrete an acrid fluid. There are no teeth. It has four fingers and five toes, and

* *Bombinator igneus.* † *Pelobates fuscus.* ‡ *Bufo vulgaris.*

these last are very slightly webbed. The eye has a transverse pupil, and the colour of the body is a brownish-grey, dirty, or lurid. The tubercles are more or less brown, and beneath the creature is dirty yellowish-white, sometimes spotted with black.

The Toad sits up very much after the fashion of a Frog, but is quite as frequently seen with its

BROWN MUD-FROG.

head nearer the ground. It does not take great leaps, for they are impossible to its short limbs and extremities, so it walks in a crawling sort of manner, often keeping its body supported on its limbs during a pretty brisk movement. It has no internal vocal pouch, and the tympanum is more or less distinct. It is a terrestrial creature, and hides up during the day in dark and damp situations, is very tenacious of life, and when it is stopped and handled, swells out its body, and some secretion comes from its glands, as well as water from the internal sac already noticed. By no means shy when kindly treated and fed, the Toad will become familiar in time. It is very curious to see them feed

when they are kept in hot-houses as destroyers of insects. Seeing a beetle or a grub, they remain stationary, the red iris of their eye looking very bright, and as soon as the prey comes near enough the mouth opens, and the tongue, which is free behind and attached within the lower jaw in front, is turned out and the prey is turned in, or quickly glued to the sticky surface. The mouth remains closed, and as the victim is swallowed whole, the eyes stare with satisfaction. A good-sized bee is taken, and sometimes a convulsive action denotes that either it has stung as it has gone down, or else that it is especially nice. A worm may be swallowed and partly return, but the Toad uses its fore-limbs to crowd it into the mouth again.

In the spring time they betake themselves to the water, and the eggs are laid in strings of three or four feet in length, each egg being covered with a glutinous coat, so that the long line is about one-eighth or one-sixth of an inch in thickness. Usually the laying is later than that of the Frog, and the Tadpole is smaller and darker, and it is not until autumn that they come to land as little Toads. Every now and then the adult Toads cast their skin, and come out brighter in colour, and cleaner. They swallow this delicate cuticle, a process which does not take place in the Frogs, who lose it piece by piece. Toads have always been considered with aversion by the public, and their general character has been most blackened by those whose imagination transcends their experience. They are very useful animals, and they destroy a great number of injurious insects, and their good lives should be considered in relation to the stories about their misdeeds, all of which are false, and the outcome of prejudiced minds.

They endure for a long time without food, and they hibernate by getting into the mud, down cracks, and into holes.

The stories about Toads being found in stones, in mines, and in trees, in positions where they must have been kept from air and food for years or centuries, are not true. Dr. Buckland proved by direct experiment that no Toad can live for two years without food and air.

The alleged venom of the Common Toad, so long a subject of popular belief, has been rejected by many modern naturalists, among whom Cuvier may be particularly mentioned. The noxious matter is in follicles, chiefly in the true skin and about the head and shoulders, but they are also distributed generally over the body, and on the extremities. The Toads possess, besides, two glandular masses (parotids), which, when pressed, exude through small holes a yellowish thick humour of a musky odour. Pressure causes this fluid to exude or even spurt out to a considerable distance. Dr. Davy found it extremely acrid when applied to the tongue, resembling the extract of aconite in this respect, and it even acts upon the hands. A chicken inoculated with it was not affected. Dr. Davy conjectures that this "venom" is a defence to the Toad from carnivorous animals, and we have seen a dog, when urged to attack one, after some hesitation drop the animal from its mouth, in a manner that left no doubt that he had felt the effects of this excretion. In a Brazilian species the secretion acts fatally on chickens when introduced into their veins.

The Natter-Jack, or Rush Toad,* is not common. It is found in some places around London, or rather was fifty years ago, and White states, in his "History of Selborne," that they were more often seen in his garden than the ordinary Toad. This Toad is of a light yellowish-brown colour, clouded with a dull olive, and there is a bright yellow line running down the back. It is a lively Toad, and it runs with the body considerably raised, and it is hardy, being often found in dry situations. Indeed, Bell notices their favourite resort at Selborne to be under a shallow layer of turf covering the top of a wall of a hen-pen, which is exposed to the summer sun, and is the hottest part of the garden. It is less timid than the Common Toad, and its eyes are more prominent, and are elevated above the head. The warts of the skin are larger than those of the Toad, but the glandular swellings are less on the head. Claus states that it has large glands on the legs, and that it runs badly; nevertheless, it often takes to the water at night, and especially to those lakes and ponds where there are reeds and rushes. They emit a smell not unlike the smoke of gunpowder. The male makes as much noise as a Frog, and cries *Glouk, glouk*. Eggs are laid in the water, and the Tadpoles are amongst the smallest, their metamorphosis not lasting much more than six or seven weeks. The Variable,† or Green Toad, found in France, has hind limbs and feet nearly as large as those of the Frog. It has an imperfect vocal sac, and calls *Mé, mé*. It swims admirably.

* *Bufo calamita.* † *Bufo variabilis.*

The Indian Toads are not very remarkable, but it is interesting to notice that varieties of the Common European Toad are found in different parts of China and the islands of Chusan and of Japan. The species, Dr. Günther states, extends from Western Europe through the temperate parts of Central Asia to China and Japan. The Natter-Jack, or *Bufo calamita*, which is found in many parts of

(1) COMMON TOAD. (2) VARIABLE TOAD. (3) NATTER-JACK TOAD.

Europe, occurs in Tibet, and the Common Indian Toad (*Bufo melonostictus*) has an immense range. It is one of the commonest Batrachians, and inhabits every part of the Continent of India from the Peninsula of Southern India to China and the Philippine Islands. In the Himalayas it extends to an altitude of 9,000 feet, and Cantor says it utters a chirping plaintive sound.

Amongst the African Toads, *Bufo carens* may be mentioned. It has a short head and a truncate nose, and a huge tympanum. The colours are red, green, and black. They are common in the interior districts of South Africa, in situations abounding in brushwood under decayed leaves. Two Toads

prettily marked and blotched with light red, grey, and dark-brown tints, are also common in South Africa,* but nothing is known regarding their habits.

The Panther Toad† is an African form, and specimens are readily found in South Africa after a shower of rain. The Water-padda, a Cape of Good Hope Toad, is oftener found in water than on land.

The marshy and swampy districts of Central America near the sea have a large brown Toad covered with low unequal tubercles, and having huge parotids. It is called the Agua.

Mr. Darwin (when in South America) wrote:—"Amongst the Batrachian reptiles, I found only one little Toad, which was most singular from its colour. If we imagine, first, that it had been steeped in the blackest ink, and then, when dry, allowed to crawl over a board slightly painted with the brightest vermilion, so as to colour the soles of its feet, and parts of its stomach, a good idea of its appearance will be gained. If it is an unnamed species, surely it ought to be called Diabolicus, for it is a fit Toad to preach in the ear of Eve. Instead of being nocturnal in its habits, as other Toads are, and living in damp, obscure recesses, it crawls during the heat of the day about the dry sand-hillocks and arid plains, where not a single drop of water can be found. It must necessarily depend on the dew for its moisture; and this probably is absorbed by the skin, for it is known that these reptiles possess great powers of cutaneous absorption. At Maldonado I found one in a situation nearly as dry as at Bahia Blanca, and, thinking to give it a great treat, carried it to a pool of water. Not only was the little animal unable to swim, but I think without help would soon have been drowned."

Amongst the North American Toads there is the Carolina Toad, about two inches and a half long, which is found in the Southern States. It has a large head and mouth, and greatly elevated ridges above the eyes, ending in a knob. The lower jaw has a hook in front, and the parotid reaches from the tympanum to the shoulder. It has an internal vocal sac, and the dusky-brown yellowish body is warty. It is a timid, gentle animal, and ventures out in the dusk of the evening. It feeds on various insects, which it seizes only when alive and in position. Catesby says it feeds on fire-flies, and will by mistake capture a piece of burning charcoal. They become tame, and one, which had some water poured on its head, returned the next day for a similar kind treatment. Another is brick-red above, and lives in the oak forests of South Carolina (*Bufo erythronotus*). The Oak Frog (*Bufo quercus*), about three-quarters of an inch long, is a pretty little Toad with a flat head and pointed snout. It is of a light colour, and has a yellowish line along the back. The belly is silvery-grey, and the groins are yellow. It likes the sandy districts where small oaks replace the pine forests. The American Toad (*Bufo americanus*) is a very warty kind, and has a white line down the back, and it is about two inches and a half long. It is a timid animal, and lives like the English Toad. Its head is smaller in proportion to the European species, and there is a process on the root of the fore toe. It is widely distributed in the Northern United States.

The next family, the Engystomatidæ, is typified by *Engystoma carolinense*. It has a small, pointed short head, and the skin is a delicate chestnut above, and mottled with black beneath. It is a South United States form, hiding up by day and coming out in the evening after heavy rains. Others occur in the Peninsula of India.

The Breviceps are Toads which have not visible parotid glands or tympanic membranes, and they have an oval-shaped body, and the head and mouth are small, the feet being but slightly webbed. One called the Rain Puddock in the Cape Colony lives in holes or burrows in the ground, from which it emerges during rain, and on such occasions croaks loudly. It has a swollen-out body, and the head is scarcely distinguishable from it, and the surface of the skin is warty. Above, it is a dirty reddish-brown colour variegated with two or four rows of dull orange spots more or less distinct. Underneath, it is dirty greenish-yellow. The pupil is transverse and the iris green. When irritated it inflates the lungs to their utmost extent, and is then like a distended bladder, and discharges an acrid mucus profusely from its pores.

The Rhinophrynidæ family are Toads which have neither tympana nor parotid glands, and the tongue is free in front, and the type is in Mexico.

The last family is that of the Rhinodermatidæ, which have no parotids, but the transverse processes of the sacrum are large.

* *Bufo angusticeps* and *Bufo gariepensis*. † *Bufo pantherinus*.

The second group of the Batrachians with tongues consists of the DISCODACTYLES, which have the tips of their large digits furnished with adhesive discs. They are usually called TREE FROGS, and the first family is the HYLORANÆ.

The Hyloranæ are interesting Frogs because, whilst the form of the head and body and the length of the limbs are very similar to those of the genus Rana, the more or less dilated extremities of the toes indicate a semi-arboreal life. These half True Frogs and half Tree Frogs are powerful leapers, and they inhabit Ceylon, the Philippines, and Archipelago, Western Polynesia, Madagascar, and West Africa. There is even a species from New Guinea.

The HYLIDÆ, the next family, have the extremity of their digits enlarged, rounded, and fashioned into a disc which is more or less sticky. They fix themselves to objects, and climb trees

ELEGANT HYLA.

with the aid of the discs. Living on trees during the summer, hunting insects amongst the leaves and boughs, some seek the water to lay their eggs and hibernate in the mud during the winter, and others lay in collections of water in the trunks of trees, and in the branches. The male has a vocal pouch which he swells out when he croaks.

The Common Hyla* of Europe is green, with a yellow and black line along the body, and is paler in tint beneath. It lays when it has attained the age of four years. The head has a soft skin, and it has, in common with the family, maxillary teeth, but no parotids. It has a large vocal sac (the male), and when in shrubs and green trees it can hardly be distinguished by its similarity of tinting. It has an immense distribution in Europe, and Günther states that in Southern China and in Formosa there is a Hyla which closely resembles the European form.

The genus is, with this exception, absent in India and Tropical Africa.

Central America has a lovely Tree Frog which is sky-blue on the back and rose-coloured beneath, and the North American Goose-footed Hyla, a large kind, is cross-barred irregularly with red and fawn tints.

The South American Tree Frogs are numerous, and some have fine noisy voices. One from Guiana and Brazil has a red-brown upper surface, yellow-white sides, and there is a curiously-shaped

* *Hyla arborea.*

line of silvery tint beginning at the eyes, and surrounding the top of the body. It is the Elegant Hyla.* Another, with a broad head, large discs, and slight webs, is a large Frog measuring three inches and a half in length, and it inhabits the same localities as the last species.†

The Common Golden Tree Frog‡ is widely distributed over Australia, and is the most common of all the Batrachians there. The natives, when pinched for food, capture large numbers by the light of a torch at night, and a supply of this Frog can always be secured in the neighbourhood of fresh water.

GOOSE-FOOTED HYLA.

In Tasmania there is a little Hyla (*H. ewingii*), which has no web on the extremities.

Hyla versicolor has a moister and more viscid look than the other species, and more resembles a Toad in form. It is a great croaker in damp weather, and it lives on trees in the Northern United States. It is a beautiful creature, and the colour varies from the palest ash to dark brown, and it is blotched with brown, green, white, and yellow.

There is a genus of this family of Hylidæ which lives in Mexico, and is remarkable on account of the existence of a pouch on the back of the female, just above the lower part of the spine. This Nototrema § is a curious form even in the Tadpole state, for its branchiæ are terminated by a disc which is bell-shaped. The eggs are placed by the hind feet of the male into the pouch of the adult

* *Hyla elegans.* † *Hyla palmata.* ‡ *Hyla aurea.* § *Nototrema marsupiatum.*

female, and they undergo their transformation and live as Tadpoles there, hopping forth in due time as perfect Frogs.

The Tree Frogs belonging to the genus Polypedates are arboreal in their habits, and have the fingers and toes ending in discs. They are found very widely distributed in the East Indies and in Madagascar, and they are very interesting from being able to change their colour. They have a smooth skin and a short fold from behind the eye above the tympanum, which is more or less distinct. The adults have vomerine teeth, and the tongue is long and deeply notched behind. The fingers are slightly webbed, and the toes are broadly so. The discs are well developed. The Common Indian Tree Frog * is one of them, and is found widely over Ceylon and the Indian Continent. It

POUCHED FROG.

ascends to an altitude of 2,780 feet in the Sikkim Himalayas, and at Penang, where it is not found in the valleys, it lives at a height of 2,000 feet. They are slender Frogs with broad heads and short snouts. They change their colours, for sometimes they are buff above, sometimes ashy-grey, or chocolate-brown tinged with rose or lilac, black spots being more or less visible.

The Spurred Tree Frog † has a flat, depressed triangular head, a large eye, the tympanum being half its size. Its fingers are not webbed, and the heel has a spur-like appendage. The male has vocal sacs. The colour is greyish or olive-yellow above, with an hour-glass black mark on the back. It is yellowish beneath, and the hind limbs have dark cross-bands. It is not rare in Ceylon. Another kind is from Afghanistan, and it is a brown Frog very finely speckled with grey.

The genus has a species in Natal, and Dr. Andrew Smith found it on the leaf of a thick reed growing on the marshy banks of a small river a little to the westward of Port Natal. Others are found in Madagascar and Japan.

There are some small Tree Frogs which inhabit Ceylon, Java, the Philippine Islands, and Borneo. They have no vomerine teeth, and the skin is smooth or else tuberculate, and their tongue is long and

* *Polypedates maculatus.* † *Polypedates eques.*

deeply notched behind. They have well-developed limbs, the fingers quite free, and the toes are webbed, the discs of the toes and fingers being well developed. The Variable Ixalus* of Ceylon is one of them, and is about one inch and a half long, the hind limb being two inches and one-third long, and is very variable in its coloration. Probably one of this genus lays its spawn in a remarkable manner. Thus, Mr. Holdsworth found in Ceylon, hanging from the side of a stone cistern, a lump of spongy soft substance as large as a crow's egg. It was found about eight inches from the usual surface of the water in the cistern. Dr. Günther examined the mass, and found it indistinctly greenish and cellular, and that it consisted of an interlaced tissue, enclosing large and small spaces, which may have been filled with air or water. A few lines below the surface of it ova were found; some in the meshes of the tissue, and others accumulated towards the centre in a lump. They were as large as a pin's head. It is remarkable that this peculiar mass of fibres of uncertain derivation should be so excellent a protection to the ova, and, indeed, a better one than the usual glutinous stuff which is secreted around the Common Frog's spawn. Whether the cells below the surface of the mass contain air to keep it floating, or whether they once contained water to support the young, is uncertain. It is known that some Tree Frogs deposit their spawn in the water which collects in the hollows of trees and branches.

Dr. Günther, during an examination of a number of small Tree Frogs from Ceylon, noticed one which had the ova attached to the under part of the body, or, rather, they were attached when the creature was caught, but came off, adhering together like a flat disc in shape, but they left their marks on the mother. They were of the size of a hemp-seed, and the Frog was scarcely two inches in length. This method of carrying the ova beneath the body is exceptional in Frogs.

The North American genus Acris has species in which the foot webs and discs are small, and it really closely resembles a small Land Frog.† It is fond of the water, and may be seen on leaves in ponds, and the male, which has an internal vocal sac, is noisy. It has a large heart-shaped tongue. Holbrook, the American herpetologist, described it as a merry little Frog, which chirps like a Cricket, and may be domesticated.

In Nepal and Sikkim, at an altitude of 5,200 feet, there is a slender, smooth-skinned Tree Frog, with a body three inches and two-thirds in length, the hind limb being six inches in length. It is one of the largest of the Tree Frogs, and is green during life, and uniform dark violet above, after death, and brownish below. The fingers and toes are entirely webbed, and the terminal discs are very large. The vomerine teeth are in two series. It belongs to the genus Rhacophorus. All the species of this remarkable genus have the digits very flat, the discs greatly dilated, and the web large. They inhabit Java, Malabar, Madagascar, and a sub-genus is on the mainland of West Africa.

The Hylodines are a sub-family of the Hylinæ, and have no web on the toes. Some belonging to the genus Hylodes have teeth on the vomer.

The little Hylodes ocularis, one of this group with free digits and vomerine teeth, is only eleven lines in length, legs and all, and is very pretty, resembling the Acris gryllus in its habits. It is found on myrtle leaves, and is diurnal in its habits, seeking its food by day. Like the others of its genus it delights in the sunshine, but they retire to dark, damp places, and sit in the water half covered. South Carolina and Georgia are their localities.

In one of the group called the Martinique Frog,‡ which is distributed in some of the other islands of the Antilles, the eggs are laid, but do not bring forth Tadpoles. On the contrary, the metamorphosis proceeds inside the egg in about seven days, and the Tadpole state is thus rapidly passed through there. When the little Hylodes bursts forth, it is a tiny perfect Frog with a little tail, but this is soon absorbed.

A family of the Tree Frogs, the Phyllomedusidæ, with maxillary teeth and parotid glands, has a very peculiar opposable condition of the digits, so that the hands and feet grasp the twigs and branches like those of Apes. One of these is from Cayenne and the Brazils, and is blue above, and the sides and legs are spotted with white. It is called *Phyllomedusa bicolor*.

The Great Green Tree Frog § is the largest of the Batrachians which is found in every part of Australia, and in New Guinea. Specimens are seen as large as a man's fist. This species feeds upon almost every living object that can be swallowed—Lizards, Frogs, all kinds of insects, and

* *Ixalus variabilis.* † *Acris gryllus.* ‡ *Hylodes martinicensis.* § *Pelodryas cæruleus.*

RHACOPHORUS RHEINHARDTI.

young birds, and the nestling of a small Honey-eater has been taken out of the stomach of one of these insatiable creatures.

A species of Pelodryas, also a member of this family, is from New Zealand, and has very large discs to the fingers, and the first finger is opposable to the other three, and is joined to the second by

a rudimentary membrane, and the others are partly webbed, the third and fourth having conspicuous tubercles. The toes are nearly full-webbed, and the discs are smaller than those of the fingers. This very pretty polychromatic Frog is not unlike a Rhacophorus, but the incomplete webs on the hands are distinctive.

The last family to be noticed, the Dendrobatidæ, has genera whose species have no maxillary teeth and no parotids. The figure is very Toad-like, and there are not webs uniting either digits or toes, but they have all these dilated at the tips. There is no expansion of the processes of the sacral vertebræ. The species of the genus Dendrobates live on trees and bushes, and the best known is from Cayenne and Brazil. It* is said to have a very remarkable power of tinting, and its blood, when applied to the wounds of green Parrakeets from which the feathers have been torn, is said to produce a red or yellow colour in the new plumage! The males have a throat sac. In all the tongue is ribbon-shaped, and much of it is free. They are usually black, with a white splash on the head, which is extended in a radiating manner over the eye; another is across the loins, and there are white branchings on the shoulder.

PHYLLOMEDUSA BICOLOR.

A little Frog two inches in length inhabits the country to the east and north-east of the Cape Colony, and Dr. Andrew Smith states that specimens are usually found in or about cavities which exist in the trunks of trees. When got out of the holes they appeared inanimate, but the influence of a warm sun soon imparted a moderate degree of vigour to them, and in a few hours after their liberation they were tolerably active and able to move from place to place. In one instance five specimens were found by a workman (unfortunately not by Dr. A. Smith) in the middle of a tree nineteen inches in diameter, and no hole led to the outside. It is called *Brachymerus bifasciatus*, and its dark body has a pretty yellow line on each flank, with spots on the limbs. The jaws and palate are without teeth. There are no parotids, and four of the digits and the five toes are free, but the tips are dilated. It probably belongs to this family.

The genus Plectropus probably belongs to this family, but the sacral transverse process is enlarged, and there are no discs to the fingers or toes. Moreover, four fingers are free from web, and the five toes are palmate. The Painted Plectropus,† of a brown ground tint, relieved with a marbling of black spots, is from Manilla.

* *Dendrobates tinctoria.*

† *Plectropus pictus=Callula picta.*

CLASS AMPHIBIA.

CHAPTER II.

TAILED AND VERMIFORM AMPHIBIANS.

THE TAILED AMPHIBIA—Characteristics of those with Persistent Branchiæ and of those that lose the Branchiæ Early in Life—Skeletal Peculiarities—THE SALAMANDERS—Distinctive Features—The Spotted Ellipsoglossa—Why so called—The Tritons—The Great Water Newt—Its Ferocity—Habits—Appearance—Rusconi's Observation of the Egg-laying Process of the Triton—Growth of the Embryo—The Mature Tadpole—The Power of Repair—The Straight-lipped Water Newt—The Common Smooth Newt or Eft—The Palmated Smooth Newt—Distribution—THE SALAMANDERS—The Spotted Salamander—Description—Where Found—Hibernation—The Black Salamander—Mdlle. Marie de Chauvin's Observations of the Changes of the Tadpole Salamander—The Genus Pleurodeles—The Genus Pseudotriton—Is the Bite of the Salamander Poisonous?—The Absurd Notion of their being Incombustible—The Genus Salamandrina—THE PLETHODONTIDÆ—The Genus Desmognathus—THE AMBLYSTOMIDÆ—The Axolotl—Their Life History—The Amblystoma, or Adult Form—THE ICHTHYOIDEA—Characters—THE PERENNIBRANCHIATA—The Sirens—Appearance—Habits—THE PROTEIDÆ—The Proteus—The Genus Menobranchus—THE DEROTREMATA—The Amphiuma Means—The Amphiuma Tridactyla—The Hellbender—The Sieboldia Japonica—THE APODA—Characters—Classification of the Amphibia—THE EXTINCT AMPHIBIA.

ORDER URODELA.—THE TAILED AMPHIBIA.

THE bodies of these Amphibia are long and rounded, tailed and webbed, and usually the fore limbs are remote from the hinder. Their small limbs, the posterior being sometimes deficient, are useful in enabling them to move on land, and, in some, in water. Their aquatic life might almost be predicted from their shape, and especially in the case of those which have the branchiæ on the side of the neck persistent. Some live more on land, and have no branchiæ during adult age, and are aquatic. It appears that the branchiated kinds, and those with clefts, have biconcave vertebræ, and that the others, which lose their branchiæ early in life, have an articular head in front of the vertebræ and a cavity behind. The first ally the others to the fish, and even a part of the notochord is visible in them. The Urodela have rudimentary ribs, and in the tail there is an arch of bones to protect its vessels. The skull, usually flat, is never completely ossified, and in the branchiated kinds the cartilaginous and membranous parts of the young skull persist. The eyes are sometimes rudimentary, and are placed beneath a transparent skin, and there is no tympanum. The teeth are usually small and curved; they are in a single row on the lower jaw, and they exist both on the upper jaw and on the palate. The tongue is fixed below, and is free at its edge. The heart in some has the auricular septum more incomplete than in the Batrachia, and in the Proteus there are three branchial arches, and the bulb of the aorta splits into two trunks; and by subdivision three pairs of aortic trunks are formed, and the bases of the branchial artery and vein anastomose in the first two gills, but not in the third. In others, and in the Salamanders, there are four pairs of aortic trunks.

The skin glands are found along the sides of some of the aquatic Amphibia, and also beneath the jaws and on the top of the head.

The Urodela are divided into sub-orders, the Salamanders and the Ichthyoidea, and these into the Perennibranchiate and Derotreme groups.

THE SUB-ORDER SALAMANDRINÆ.—THE SALAMANDERS.

These Lizard-shaped Amphibia are tailed, and breathe by internal lungs. They have eyelids which are horizontal, and the vertebræ are convex in front and concave behind. They have no branchiæ, or gill clefts, in their perfect or adult age, but some have them during their youth. More or less Lizard-like in shape, the fore limbs are furnished with four and the hind limbs with five digits. Their skin is glandular, viscid, and often secretes a milky liquid which is acrid. In some the glands aggregate near the ear, as in the Toads, and some have the gift of changing colour, through possessing movable colour cells. The males and females differ, and the first have a fin-like crest usually on the back and tail.

They are usually divided into four families, and the first is typified by a Japanese kind which appears to link the land-living and the aquatic Salamanders together

It is long-bodied, and has a short tail, which is more and more compressed towards the tip. The head is small, and the neck also, and it is rounded. Its eyes project, and the nostrils are well in front. The skin is smooth, and as it were polished, and has folds and mucous pores, and is of an ashy-grey or blue-grey colour marked with white on the flanks. It is a small animal with four digits, and is called, from having an oval-shaped tongue, *Ellipsoglossa nævia* (the Spotted Ellipsoglossa). Another kind is, on the contrary, fitted by its compressed body and tail for living in water, and is the Clouded Ellipsoglossa, and is also from Japan.

The next family, the Salamandridæ, contains the Newts and Efts, and the Salamanders, and although the well-known shape and the outside characters would enable its genera to be associated more or less, it is advisable to state that the members of this family have the palatine teeth implanted on the inner margin of the diverging and posterior prolongations of the palatine bones, and that they are in two rows placed longitudinally and diverging posteriorly.

The Tritons (genus Triton) are numerous in species and individuals, and besides the structural peculiarities of their family, they have the body covered with warty tubercles; the four short limbs have toes, four on the front, and five on the hinder, and are without nails. The male has well-marked crests on the back and tail, which are not continuous, and there are no parotids, but there are glandular pores above and behind the eyes, and also a longitudinal series of similar pores on each side of the body. They are very Lizard-like in shape, and the tongue is globular, free at the sides slightly, and free behind, where it is pointed.

The Great Water Newt* (Plate 48) grows to the length of six inches, and is the largest of the British kinds. Common in ponds and ditches, it preys upon the water insects, and during the spring feasts on the Tadpoles of the Common Frog. They even devour the other and smaller species of Triton, which they seize, according to Bell, with ferocity, and hold fast in spite of the efforts made by the victim to escape. They will bolt specimens of the Small Eft, which wriggle and give much trouble in the act of swallowing. It is a very aquatic species, and rarely leaves the water, and during the winter it remains torpid at the bottom of ponds and ditches until the warmth of spring returns. It has a flat head, and the upper lip overhangs the lower, and the trunk is nearly continuous with the head, the intervening neck being marked with a fold of skin. The body is thick and round, and the upper parts are blackish-brown with darker round spots, and the under are bright reddish-orange, with round black spots. The sides are dotted with white, and the sides of the tail in the male are a beautiful pearly white. The male has a back crest during the breeding season which disappears in the winter. They swim principally with the tail, the legs being turned backwards; but when they float on the surface of the water they sprawl their limbs out and their toes also. At the bottom of ponds and on land they crawl with the aid of their weak extremities. They change their skin, and it comes away in shreds. The female is like the male in the winter, but she has no trace of a tail crest. The Prince of Musignano states that the Newt dies in convulsions if salt be sprinkled on it. The egg-laying is a curious process.

Rusconi noticed, whilst watching the egg-laying of the Triton, that the females from time to time pressed back their hind limbs, and that in a few moments after this action they laid one or two eggs, which remained attached to them, so that some of the animals might be seen moving to and fro in the tub, with two or three eggs thus attached.

He made a small bunch of the plant *Polygonum persicaria*, and put the stems of them under a large stone to confine them at the bottom. In the evening he inspected the tub, and found all his Tritons so comfortably accommodated by the help of the plants, that by keeping the head a little elevated their nostrils were kept above the surface of the water, so that their respiration was easy.

Whilst under the influence of surprise at this, he observed one of them approach one of the leaves of the plant, as if to smell it. The animal then moved gently on the leaf in the direction of its breadth, and, resting upon it, pushed back its hind limbs so as to fold back and enclose the leaf between its feet. It stayed about a minute in this position, and then went away, leaving the leaf so that its apex was turned back on the petiole. After a lapse of three minutes, Rusconi saw the Triton approach another leaf, apparently disposed to place itself thereon, when, casting his eyes accidentally on the other branches, he discovered many other leaves doubled back. He immediately took the bunch

* *Triton cristatus.*

GREAT WATER NEWTS.

from the tub, and on examining the leaves which the Newt had doubled and stuck with a sticky secretion, he found that each of them enclosed an egg.

On looking at one of these eggs, it will be observed that the future Newt, or embryo, is in the centre. It is white, with a yellow tint, and is environed with a glairy matter, to which it is so attached that it can move freely in every direction. Its envelope is membranous, of glassy transparence, and is covered with a very clear viscid matter.

The growth of the embryo is rapid under the influence of warm weather, and in five days, according to Rusconi, it is bent in shape, and little knobs are near the larger end, and on the seventh they are evidently the rudiments of gills and legs. By the ninth day, the tail is oar-like in shape, the heart may be seen to beat, and on the next day there are on each side of the head the rudiments of an anterior limb, also claspers besides the gills. In two or three days the eyes are seen, and the gills have become leaflets, and the little one escapes into the water at about the fourteenth day. It moves in a very mechanical way, and hangs on to the first object with its clasping hooks. In about twelve days the fore feet have become lengthened, and there are rudiments of toes, and red blood circulates in the branchiæ, or gill-like leaflets, and the claspers have disappeared; moreover, there is much volition, and the little thing hides up and rushes after its prey. The hind feet appear on the thirty-fifth day, and attain a good development by the forty-seventh, and the longest gills have as many as twenty leaflets full of vessels. The Tadpole matures on the eighty-third day, and then the gills become smaller, and are soon obliterated, so that in five days, or shortly after, they and the clefts in the neck for the outward passage of water taken in at the mouth begin to be absorbed and covered with skin. It soon respires atmospheric air only, and having thus arrived at its perfect state, it makes efforts to escape from the vessel in which it has been isolated. This species lives in and on the water, and is seldom to be found on land.

They have, in common with most other Salamandroids, the power of repairing great injuries to the body. Loss of the limbs, tail, and even head, has been followed by a process of repair.

Mr. Bell has described a straight-lipped Water Newt* which is a rare British species. It has a rough and tubercular skin, more so than in the Great Newt, and its upper lip does not overhang, but is straight. He also places the Common Smooth Newt, or Eft,† in a genus called Lissotriton, but it may as well remain in the genus Triton, for the only essential differences are that the skin is smooth, there are no pores on the sides, and the crest of the back is continuous with that of the tail. It is very common and likes clean water, and it feeds on worms, minute mollusca, and water insects and gnats, but it is devoured by larger Newts and fish. They lay on the folded leaf like the Great Newt, but quite as often in the axils of the leaves, and after the tadpole state many quit the water and remain on land. Many of the adults may be found creeping about among the herbage in damp places, or even venturing into damp cellars. The crests are seen in the spring, and are lost in the autumn, when the colours of both sexes become dull. The tips of the crest are red, and the belly is bright orange in the early part of the year. They lose their skin in a whole piece sometimes, but usually in strips. Their length is about three inches seven lines in large specimens, the tail being one inch and three lines of the whole.

The Palmated Smooth Newt‡ has the hind feet webbed in the male, and the tail is truncate with a slender end. The beak is flattened, with a raised line on each side. It has been found near Bridgewater, the Isle of Wight, Reading, near Edinburgh, and as far north as Sutherland. It was supposed to be a kind which is found in Switzerland, France, Central Germany, and Belgium, but the English species is smaller, its head is flatter and broader, and the low lateral ridges are characteristic. The webbed state of the hind feet, although it diminishes in winter, and the straightness of the back crest, are very peculiar. The filament which ends the tail is from two to four lines in length.

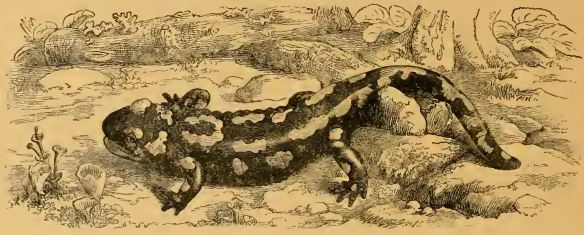
THE SALAMANDERS.

The Spotted Salamander§ is the type of this genus,‖ and it has a thick, large head and clumsy body, and a tail which is cylindrical at its outer end. The eyes are large, and the body is of a black colour, with yellow spots, and there are numerous prominent warty growths on the sides. It has a large

* *Triton bibronii.* † *Triton punctatus. Triton vittatus* (Gray) is a variety. ‡ *Triton palmipes.*
§ *Salamandra maculosa.* ‖ *Salamandra.*

tongue. The teeth on the palate are in long series, and the mouth-gape is ample. The parotids are very developed. The toes are free and smooth.

This is a dweller on land in the adult state, and is found in Central Europe, in the mountainous



SPOTTED SALAMANDER.

districts of Southern Europe and North Africa. They haunt cool and damp places, such as fallen timber and old walls, and they feed on insects, worms, and slugs. They hibernate in the winter, coiled up in the crack of a wall, the hollow of a tree, or in the ground; and during the spring and summer, they shed their coat in shreds.

The Black Salamander* is found in the high mountains of Central Germany, France, and Switzer-

PLEURODELES WALTLII.

land, and it has of late years been studied in regard to its extraordinary viviparity. The young undergo their metamorphoses in the body of the mother; but only the lower eggs in the body are hatched within, and the resulting Tadpoles appear to destroy the others. Mdlle. Marie de Chauvin, by taking the young from the body before they were fully developed, and placing them in water, tried to watch the changes of the Tadpole Salamander, but only in one instance did she succeed. In four days

* *Salamandra atra.*

the little Tadpole got rid of its gills, which were replaced by others of an unusual form, and the new ones adapted the creature to its novel existence. It lived for fifteen weeks at the bottom of the water, and grew considerably. Then the gills atrophied, and the tail and skin altered, and finally, after moulting its cuticle, the Salamander quitted the water, and then the gill-clefts closed, and it became an adult Land Salamander. This observation is interesting in connection with the history of the Axolotl, which has branchiæ in early life, and may lose them later on.

The next genus, Pleurodeles, has short ribs, which give the appearance as if they penetrated the flanks, but their ends come against the tissue under the skin, and produce horny projections thereon. The tail is long and compressed, and the small tongue is adherent only in front, and there are two series of palatine teeth in longitudinal series. The Spanish kind has an ashy-grey body,* very prettily marked with long transverse stripes and dots. It is very like a heavy Lizard.

The genus Pseudotriton includes a red kind with numerous small black points, and the abdomen is orange-red. It is a land animal, and is found under rocks and fallen and decaying trees. It will take to the water, and this pretty little thing lives on insects, and is a North American kind.

There have been many stories about the Salamanders producing poisonous results, and an able writer in the "Penny Cyclopædia" may be thus quoted regarding them :—

"The body of the Salamander is largely covered with warty glands. These secrete a milky fluid of a glutinous and acrid nature, which, if not capable of affecting the larger and more highly organised animals, appears to be a destructive agent to some of those which are less highly organised. Thus Laurenti provoked two grey Lizards to bite a Salamander, which at first attempted to escape from them, but being still persecuted, ejected some of this fluid into their mouths ; one of the Lizards died instantly, and the other fell into convulsions for two minutes, and then expired. Some of this juice was introduced into the mouth of another Lizard : it became convulsed, was paralytic on the whole of one side, and soon died. According to Dr. Barton, this fluid—which the animal secretes in large quantities when irritated, and is then capable of ejecting it to some distance—is not soluble in water, though it dissolves readily in spirit of wine. He found the taste of the juice of *Salamandra subviolacea* extremely acrid, resembling corrosive sublimate, and very astringent.

"Such is the extent of the foundation for the long-cherished assertion that the Salamander was one of the most venomous of animals. Nicander, in his 'Alexipharmaca,' gives an appalling picture of the symptoms produced by its bite. The Romans looked on it with horror as most destructive, and considered it as deadly a part of the poisoner's laboratory as aconite or hemlock. Hence came the proverb that he who was bitten by a Salamander had need of as many physicians as the animal had spots ; and another still more hopeless :—'If a Salamander bites you, put on your shroud.'

"But the grand absurdity of all was the belief that the Salamander was incombustible ; that it not only resisted the action of fire, but extinguished it, and when it saw the flame, charged it as an enemy which it well knew how to vanquish."

The last genus of this group is Salamandrina, and a species is found in Italy and Dalmatia. They are small Salamander-like creatures, and their head has a triangular reddish spot, and the rest of the upper part is black. Beneath the body the colour is white, spotted with black, and the under parts of the thighs are reddish. The tail, cylindrical in shape, has sharp ridges above and below, and the hind feet have four free digits. The tongue is fixed in front, and the palatal teeth, parallel in front, are divergent behind. They are barely two inches in length.†

The next family are the PLETHODONTIDÆ, and a species (*Plethodon glutinosa*) has a cylindrical body, with a lax skin, which is folded on the back. The tail is very long, the head large and flat, and the palatine teeth are in two long converging lines. The colour is dark or blue-black, and there are little white spots on the sides of the skin and stomach. It is found from Massachusetts to Florida.

The genus Desmognathus is one of the family, and its species have the posterior half of the tongue free, and it can be ejected beyond the mouth. Mr. Leiss, writing in the *Scientific American*, may be thus quoted about the brown species, which lives in the North-Eastern part of the United States :—

"They inhabit the shallow and stony spring brooks of hillsides and springs. I never have found them far away from spring water. They are rarely seen swimming, but must be looked for beneath the

* *Pleurodeles waltlii.* † *Salamandrina perspicillata.*

stones. When a stone, beneath which one is hiding, is first lifted up, the Desmognath is generally surprised and dazed, and remains quiet for a few seconds. It must then be quickly seized, or it darts off into the water and escapes.

"The metamorphoses of this species do not differ materially, so far as I have observed, from our other Batrachia Urodela. The young are furnished with gill-tufts, and are entirely aquatic in habits. When young they are lighter in colour than the adult, and often assume the colour of the mud or sand of the stream they inhabit, and are thus not easily detected. The Brown Desmognath feeds upon earthworms and insects. I found in the stomach of an individual three inches and a half in length an earthworm over two inches long.

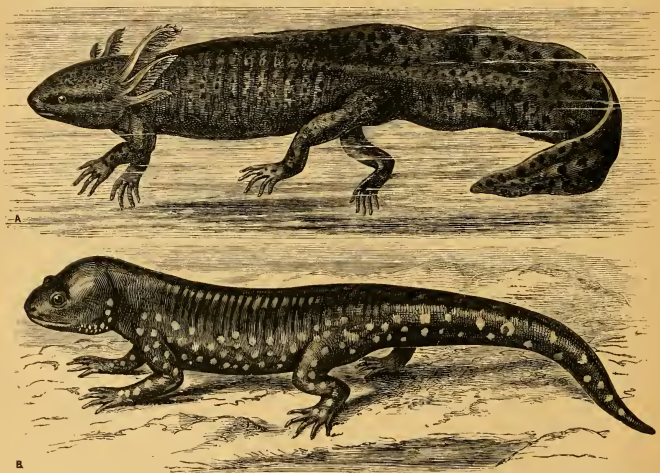
"The generic name, Desmognathus, means band, or ligature jaw, so called on account of the tendinous ligament (one on each side) passing from the atlas over the parietal and pro-otic bones to the jaw. This, like a ligamentum nuchæ, supports, or rather, in this case, gives great power to the head, which is necessary in pushing up stones when in search of the worms upon which it feeds.

"The stagnant water of the aquarium seems ill fitted for the life of this lover of spring brooks, for we could never succeed in keeping them alive for more than a few weeks."

The history of the early life of these non-branchiate Amphibia with tails is interesting, and it is very probable that some of the perennibranchiate Amphibia are really the larvæ, or immature forms, of others of this sub-order. This is evidently the case in the next family.

THE FAMILY AMBLYSTOMIDÆ.

One of the most interesting of the Mexican Amphibians is the so-called Axolotl, or Siredon, which lives in the lake which surrounds the city of Mexico. They are like stout, short-legged Lizards in shape, and are from eight to ten inches in length, and have short extremities, there being four digits to the fore limbs and five to the hinder. The colour is dark grey, or almost black, with dark spots, and there are three well-developed branchiæ on each side of the neck. There are teeth in



AXOLOTL IN THE EARLIER (A) AND IN THE LATER (B) STAGES OF ITS EXISTENCE. (*After Duméril.*)

the jaws, and two lines of them on the vomer. Cuvier had doubts about placing the Axolotl amongst the Amphibia with persistent branchiæ, but he stated that so many witnesses gave evidence in favour of the branchiæ not being lost during growth that he was obliged to do so. Time and research have produced a curious history about these creatures, and have demonstrated their relation to a perfect and non-branchiate form.

The Axolotles, furnished with gills, reproduce by laying eggs, and at first this was considered sufficient to determine that they were perfect animals, and that no further growth or change was possible. They were placed by zoologists in a genus of the perennibranchiate Amphibia. But in 1865 M. A. Duméril saw the Axolotles lose their branchiæ, and become altered in shape. They resembled in this the Tritons and Salamanders, or non-branchiate group, and they became Amblystomes, a kind of Amphibian which had been known before. Some Axolotl eggs turned to creatures like the parent, but after a while they lost their gills and became Amblystomes.

The Axolotles can thus become "by metamorphosis" Amblystomes,* or adult forms.

Subsequently Axolotles were watched, and the eggs they laid were placed, first, on dry ground, secondly, in water, out of which the young could readily emerge. Out of those under the first condition four turned as usual to Axolotles, and two were born as perfect gill-less Amblystomes; and under the second four turned to Axolotles and one to an Amblystoma. Then an Amblystoma laid eggs, and they were placed under the circumstances mentioned above, and many more Axolotles were produced than Amblystomes.

One of the Amblystomes thus obtained laid eggs on a certain 17th of April, and tadpoles were soon produced, and they grew to four inches in length in three months. They presented all the characters of Axolotles, but the colour of the markings of the skin differed. It is evident that the immature Amblystoma (the Axolotl) lays eggs, and that the perfect form (Amblystoma) is not sterile, but can produce eggs, some of which develop into the usual larval or Axolotl forms, and others into Amblystomes, and the surrounding conditions appear to have to do with the direction of this evolution. The Amblystomes are numerous, and have the skin much folded on the body; the tail is thick and almost cylindrical at the base. They have palatine teeth, forming two transverse rows, which are re-curved, and the tongue is large and fixed inferiorly.

The Mole Amblystoma† is a little short-tailed dweller in the light soils of the islands on the coast of South Carolina, and its underground retreats can be discovered by the slight upheaval of the earth which accompanies them.

The Tailed Amphibia are very sparingly distributed in India, and Dr. Günther mentions one genus, Cynops, which has species in China and Japan, and another, Plethodon, which is North American, and has one species in Siam. *Plethodon persimilis*, from Siam, is so similar to *Plethodon glutinosus*, from North America, that Dr. Gray stated that at a first glance they might be considered to be identical.

Mr. Wood Mason has noticed a Newt from the Darjeeling Hills, and it is the first from British India. It has horny matter accumulated at the points where the ends of the ribs project against the skin, as in the genus Pleurodeles.

SUB-ORDER ICHTHYOIDEA.

These are the lowest, so far as organisation is concerned, amongst the Tailed Amphibia, and present, as it were, the early life of the first sub-order, the Salamandridæ. The larval state of these last is persistent in the adult Ichthyoidea, which, more or less fish-like in construction, have in the vertebral column remnants of the notochord, and the vertebral centra are concave in front and behind. Even the teeth on the palate resemble those of fish. In one group of the sub-order the branchiæ are persistent, and there are always gill-clefts, and these are called the perennibranchiata, and in another the external branchiæ are not found in adult age, but there are gill-clefts. These are the Derotremata.

The first group, the PERENNIBRANCHIATA, have long bodies, short limbs, the hinder pair being deficient in some, and the branchiæ are persistent in all, and so, of course, are the gill-clefts. Usually, there are no superior maxillary bones, and the palate is armed with rows of teeth. There are three families, and the first is that of the Sirens (*Sirenidæ*), of which the Siren is the type.

* *Amblystoma mexicanus.* † *Amblystoma talpoidea.*

The stagnant waters and marshy ground of South Carolina, especially where rice is cultivated, are frequented by a very eel-shaped creature of an olive or blackish colour.* It has the anterior limbs, which are small, ill-developed, and bearing four digits each; but there are no hind limbs. The tail is flat from side to side, and there are on each side of the neck three very visible gills, increasing in size from the first to the third, and bearing branchial branches. Its eyes are small and covered with skin. The gape of the mouth is not great, and there is no visible ear. Its lower jaw has a horny sheath and several rows of small teeth, and the upper jaw is toothless, but there are teeth on the palate. It lives in the mud, and travels into the water or on to the land occasionally, and it preys on earthworms and insects. In captivity it hides in the mud and devours meal-worms. This lowly-organised Amphibian retains its branchiæ and gill-clefts, three in number, through life, and the blood corpuscles are elliptical in outline, nucleated and vast in size, being $\frac{1}{150}$ of an inch in length. The lungs are bag-like and long. The Siren has amphicœlous vertebræ and small ill-developed ribs, and the wrist and the ankle are cartilaginous.

The usual length of the head is one inch, and of the body and tail eighteen inches, but they frequently attain the length of three feet. This Siren is covered with a thick mucus, and has a disagreeable smell. When it wishes to inspire it rises to the surface, about three times in twelve hours, and it gets rid of some air under water about once in two hours. It is, however, only an occasional inhabitant of water, and it prefers to live in moist clay or mud. They abound in the rice-fields, being thrown out on the land at certain seasons, when the ditches are cleaned. Formerly they were killed by the slaves, or mangled as being poisonous, and left to be devoured by birds and beasts of prey. Sometimes they leave the soft mud in which they burrow, and take to the water, in which they swim with great swiftness, and at others they go on dry land, but whether in search of food, or to rid themselves of parasitic insects, cannot be determined. Their range is from 45° N.L. to East Florida. They were first observed in South Carolina, and Dr. Garden noticed to Linnæus that they lived in dams and ponds.

FAMILY PROTEIDÆ.

The Eel-shaped Proteus is the type, and is found in Carniola and Dalmatia, living in the great underground wet caves and subterranean lakes and streams of those remarkable districts. It looks, when swimming, something like a Lizard, with small and very distinct hind and fore limbs, but there is a tuft of branchiæ on each side of the neck. The creature is more than a foot in length, and of the thickness of a finger, and the tail is compressed vertically. The fore limbs have three short digits, whilst the hind ones have two. Only two gill-clefts exist on each side, and there are rudimentary lungs besides the branchiæ. They are flesh-coloured creatures, and the gills are coral red, and the eyes are hidden in the skin, and are small, but useful. The blood corpuscles are immense, and about fifteen times the size of those of man.† A rather long but truncated snout is seen, and the palatine teeth are in two long rows.

A third family was formerly established to receive the remarkable North American genus Menobranchus, but it is by no means certain that these creatures are not the larvæ or the immature condition of an Amblystome called Batrachoceps. The *Menobranchus lateralis* is from the Mississippi, and the Spotted Menobranchus ‡ comes from Lake Champlain and elsewhere in the lake district of North America. The first has a long body, a flat and broad head, a large compressed tail, curved above. The eyes are small, the nostrils are in front, and the beautiful crimson-coloured branchiæ are three in number on each side, and there are two clefts on each side of the neck. The tongue is broad, entire, and free at the fore part, and there is a long, arched series of concentric teeth on the palate, on the front of the vomerine bones. The lower jaw has a pointed set of teeth, and the lips are fleshy. The extremities are four-cleft, and they are without claws. It is of a dusky ash-grey, with dark spots, and there is a streak from the snout over the eyes. They were first caught in baiting for Cat-fish, and were, of course, reputed poisonous, and much was made about them, although they do not often measure a foot in length. They crawl on the floor of the water, or swim with a serpentine movement, and feed on insects, worms, and shell-fish.

The second group of the Ichthyoidea, the DEROTREMATA, is remarkable for not having branchiæ

* *Siren lacertina.* † *Proteus anguineus.* ‡ *Menobranchus punctatus.*

MENOBRANCHUS LATERALIS.

in adult age, and for having a gill-cleft on each side, and there are two families of them. The first, the Amphiumidæ, is represented by the long eel-like Amphiuma, of which there are two species, one with two and the other with three rudimentary digits. The first, *Amphiuma means*, lives in muddy waters, or in mud. Harlan says they have been found at Pensacola, three feet or more deep in mud of the consistence of mortar, in which they burrowed like earthworms. They inhabit the ditches of rice-fields, and feed on fish and the fresh-water Unio, on beetles, and other insects. Sometimes they are found on dry land. North and South Carolina, Florida, Alabama, and Mississippi are their commonest localities. The whole surface of the body is deep blue-black, tinged with violet, and the lips and throat are light, and the belly is dark-coloured. The single branchial cleft on each side is partly covered with a thin fold of skin. The body is eel-shaped, and the fore-limbs, close to the gill-clefts, have two small fingers, and the hind ones have the same number of toes. The tail is very long and compressed near the tip. The negroes call it the Congo Snake.

The other species, *Amphiuma tridactyla*, is so called from the number of its digits, but it appears, from the researches of Mr. Ryder, that the number of digits may vary in the same individual Amphiuma; there may be two or three. It is said that those with three digits invariably present are restricted to the Southern United States, while the two-toed form is more widely distributed, extending farther north, and also embracing the distribution of the former. Probably the distinction attempted to be made between Amphiumæ with two and three toes is of no great importance.

Another family, the Menopomidæ, is represented by the Hellbender.* This ill-named Amphibian has a large, flat, broad head, and the snout is full and rounded, and the body is short, thick, and the tail is large, much compressed, and has a fin above. It is of a pale slate colour, mottled with dusky tints. It is carnivorous and very voracious, feeding on fish, worms, and shell-fish. It is found in the Alleghany river and its tributaries, and doubtless inhabits many of the branches of the Ohio and Mississippi. The mouth is large and covered with fleshy lips. The tongue is thin, broad, and flat, and is attached behind and below, and is free in front and at the sides. The superior maxillary teeth are arranged in two concentric series. The nostrils are in front, and are small, and the eyes are minute and black. The neck has a single gill-cleft at each side. The fore

* *Menopoma alleghaniensis.*

limbs are short, thick, and fringed, and there are four fingers and five webbed toes. The total length is eighteen inches to two feet.

There is usually a specimen of a great, flat, almost triangular-headed Amphibian, which belongs to this family, with glistening white tips to its toes, in a glass case filled with water in the Zoological Gardens of London. It never seems to move, and a number of fish, supposed to be for its food, swim about it with perfect unconcern. It is a large, flat, Lizard-like thing, with a great tail, flat from side to side, and is nearly a yard in length. The eyes can scarcely be seen, and the dirty brown-coloured skin is warty and leathery-looking. No branchial clefts can be seen, and there are four toes in front and five behind. There is a kind of lobe behind the feet, and others on the sides of the toes, and a curious leathery skin fold is on the flanks of the body. The tongue is not distinct, and there are numerous palatine teeth.

It is a native of Japan, and is called after the naturalist Siebold *Sieboldia* (or *Cryptobranchus*) *japonica*, or is included in a genus Cryptobranchus.

ORDER APODA.

The last Amphibians to be noticed belong to this order, and have a serpentiform body, no limbs, and there are little scale-like bodies covering them, which are embedded in the soft, true skin, forming transverse rings. They have the shape and method of life of the Blind-worms, and of some of the small Snakes which lead a subterranean life, burrowing in the ground and eating worms and insects. But their internal anatomy distinguishes them readily. They have the eyes covered with skin; but all the anatomical parts of the eye are present, and vision takes place. Their mouth is

SIPHONOPS ANNULATA.

small, and situated on the lower surface of the head, and there are two rows of teeth on the mandible. The two nostrils are well in front on the muzzle. One of them is found in the warmer parts of North America, growing to the length of twenty-three inches,* and having the thickness of a good-sized worm. It is agile under ground, moving in its own or other burrows; but little is known about its habits. It has some short conical teeth in the jaws and palatine bones, and has a little pit on the head on each side beneath the nostril, which is rather projecting. Certainly, during adult age, there are lungs, one, the right, being larger than the other, and there are no gill-clefts. But J. Müller states that when young there are internal branchiæ opening outwards through a cleft, in one kind, whilst it is certain that in other kinds the young are born breathing through lungs. But Gervais and Peters state that large vesicles, branchial in character, are found on the neck of the recently hatched individuals. The vertebræ are numerous and the centra are amphicœlous, and they have minute ribs. As in the other Amphibians, there are two occipital condyles to the skull and the hyoid bone, and the persistence of its arches would indicate that there is much to be learned regarding the early condition of these animals.

Mexico and the Brazils have another genus with a short muzzle and a broad and annulated body, and the pit is situated between the eye and the nostrils.† In Ceylon there is a flat-headed species with a pit in front of each eye,‡ and in Cayenne one exists without this little place at all.§

There are some peculiarities in the skulls of these burrowing worm-like Amphibia which Huxley has pointed out were foreshadowed in the great extinct Labyrinthodontia of the early age of Reptiles. The skull has a complete bony roof, and there is a quadrato-jugal bone besides the membrane bone, or temporo-mastoid. There is also a bone which seems to be the side nose-cartilage ossified, and another encircles the orbit, having no resemblance to any bone in the other living Amphibia. Moreover, the palate bones surround the back and outer edges of the inner nostrils.

CLASSIFICATION OF THE FAMILIES OF THE CLASS AMPHIBIA.

- Order Anoura (Batrachia proper).
  - Sub-Order Aglossa
    - Family Pipidæ.
    - „ Dactylethridæ.
    - „ Myobatrachidæ.
  - Sub-Order Phaneroglossa.
    - Group Oxydactyla
      - Family Ranidæ.
      - „ Pelobatidæ.
      - „ Bufonidæ.
      - „ Rhinophrynidæ.
      - „ Rhinodermatidæ.
      - „ Engystomatidæ.
    - Group Discodactyla
      - Family Hylidæ.
      - „ Phyllomedusidæ.
      - „ Dendrobatidæ.
- Order Urodela.
  - Sub-Order Salamandrina
    - Family Molgidæ.
    - „ Salamandridæ.
    - „ Plethodontidæ.
    - „ Amblystomidæ.
  - Sub-Order Ichthyoidea.
    - Group Perennibranchiata
      - Family Sirenidæ.
      - „ Proteidæ.
      - „ Menobranchidæ.
    - Sub-Group Derotremata
      - Family Amphiumidæ.
      - „ Menopomidæ.
- Order Apoda — Family Cæcilidæ.
- Order Stegocephala
  - Group Ganocephala.
  - „ Labyrinthodontia.
  - „ Branchiosauria.
  - „ Microsauria.

THE EXTINCT AMPHIBIA.

The most ancient Amphibia appear to have first lived during the Carboniferous age, and all were tailed, had pleurodont teeth, simple in their construction, and apparently there were no bony branchial arches present. The vertebral centra were ossified. Some were Lizard-like and others were more Serpentiform, and one genus probably had no limbs. They are the Microsauria

* *Cæcilia lumbricoides.* † *Epicrium hypocyanea.* ‡ *Siphonops annulata.* § *Rhinatrema bivittata.*

(Dawson), and the genera Hylerpeton (Owen), Hylonomus (Dawson), Brachydices (Cope), and Ophiderpeton (Huxley), are typical. Associated with these, in the same formation, were the Ganocephala of Owen. These were like Salamanders in shape, and they had branchial arches, and the genera Archegosaurus and Dendrerpeton are typical genera. Numerous branchiated flat-headed Branchiosauria (Fritsch) lived in the Carbo-Permian age, and they had simple teeth and the usual accessory bones of the skull, relating to the respiratory apparatus.

The Labyrinthodonts, with some alliances to the Apoda, had a very Crocodile-looking skull, but covered over by ornamented plates. It was broad behind—in one instance two feet broad and three feet long—had well-marked orbits, nostrils far in front, and long plates over the whole, very beautifully ornamented with ridges and grooves. The gape was wide, and the upper and lower jaws and palate bones were provided with conical teeth, some much longer than others. The cement of the tooth, instead of being folded around the tooth, is inflected or turned in, and not in a simple straight direction, so as to present in a cross section the appearance of straight spokes to a wheel, but in a curved and bent or serpentine direction. Moreover, the pulp cavity is subdivided into many radiating and branching segments, so that the combination of the outer and inner markings produces a most beautiful labyrinthic pattern. This condition was foreshadowed in some of the most ancient armour-plated fish, and is slightly noticed externally in some of the fossil marine Reptilia. The limbs were feeble in relation to the body. The markings in the clay and sandstone of Storton Hill, near Liverpool, as at Hessburg in Saxony, resemble "hands," and they are the solid casts or impressions in relief of the five digits and claws of Labyrinthodonts. The possessor was called "Hand beast," or Chirotherium. The limbs were Frog-like to a certain extent, and the chest and belly were protected with bony plates. The Labyrinthodonts were probably air-breathers in adult age only. Very Batrachian in their affinities, they were tailed, and there were two occipital condyles, and ossified vertebræ. They lived in the Carboniferous, Permian, and Triassic ages.

The ornamentation of the bones of the face, jaws, and skull, was remarkable in some instances, as was that of the bony skin plates; and the shape of the skull, elongate and Crocodilian in some, was like that of a broad-headed Frog in others. Mastodonsaurus, Anthracosaurus, Pholidogaster, Baphetes, Trematosaurus, Labyrinthodon, Brachyops, Bothriceps, and Odontosaurus are well-known genera. The Microsauria, Ganocephala, Branchiosauria, and Labyrinthodontia, may be united in the order Stegocephala (Cope).

The Tailed Amphibia have been found fossil in Tertiary strata, and one in particular, at Œningen, a great depository of fossils. It was so large and peculiarly formed that it was at first considered to be a human skeleton, and its discoverer named it *Homo diluvii testis*. Cuvier, however, showed that it had belonged to an Amphibian of a Salamander type. It is since called after the discoverer *Andrias scheuchzeri*. It is a Sieboldia or Cryptobranchus.

Tritons and small Salamanders have also been found fossil in Tertiary strata.

The genera Rana and Bombinator have been found represented by fossil species in early Tertiary deposits, and the extinct genera Palæobatrachus, Palæophrynos, and Latonia, are of the same and subsequent age.

P. Martin Duncan.

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